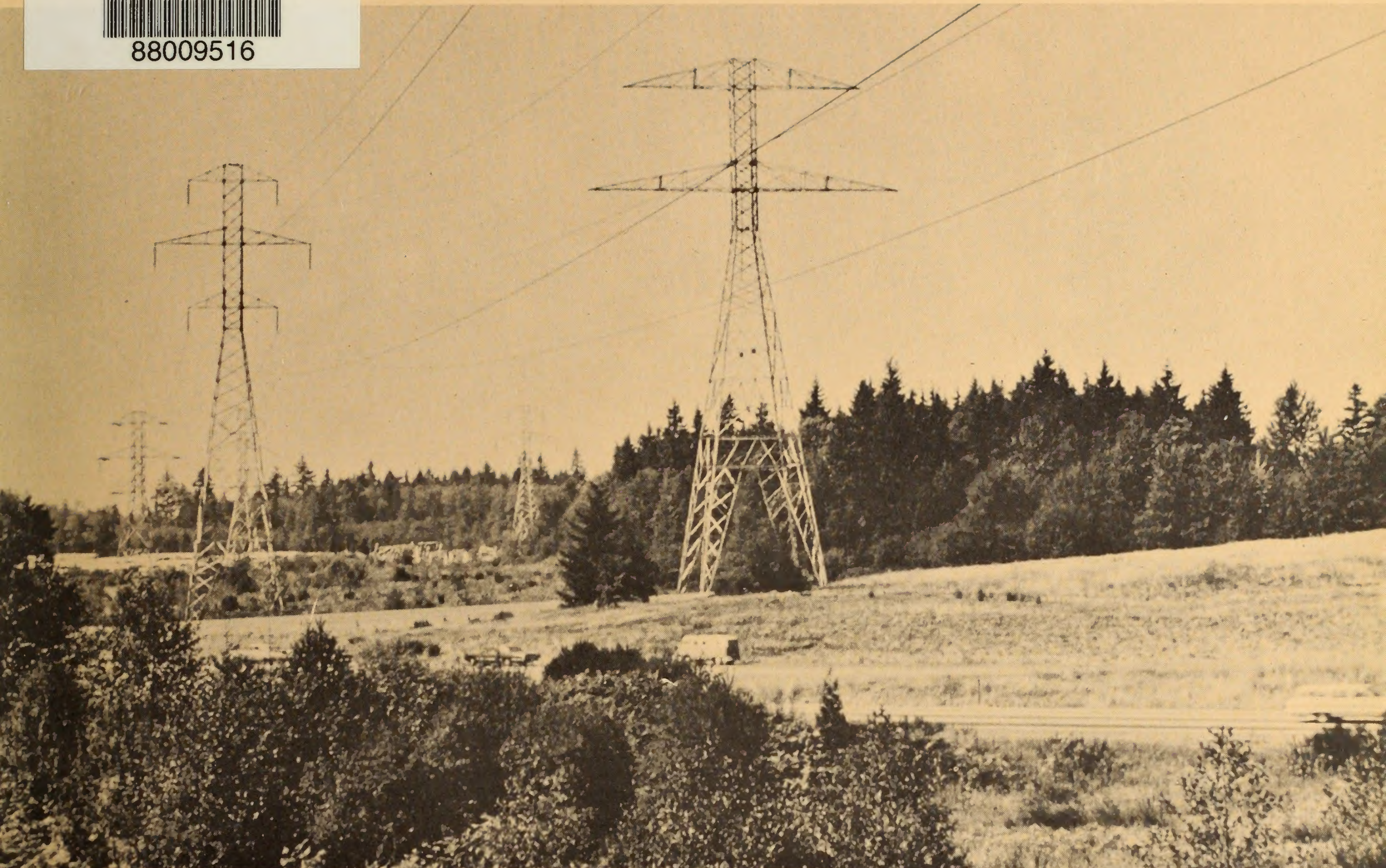

DEVELOPING NUMERICAL VALUES TO ESTIMATE POTENTIAL ENVIRONMENTAL IMPACTS of POWER TRANSMISSION CORRIDORS

by

Federal Colstrip Transmission Corridor Study Project Team

BPA BLM FS

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U.S. FOREST SERVICE, REGION 1

A Federal Interagency Effort

STATEMENT

This report was prepared by the Federal Colstrip Transmission Corridor Study Project Team, an interdisciplinary, interagency Study Team composed of representatives from Bonneville Power Administration, Bureau of Land Management (Montana State Office) and U.S. Forest Service (Region 1). The statements, procedures and methodology described in this report are solely those of the Project and do not necessarily reflect the views of the sponsoring agencies.

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ABSTRACT

A procedure was developed for evaluating potential environmental impacts of alternative electric transmission corridors for the Federal Colstrip Transmission Study Project. This procedure is employed to convert mapped environmental information from a wide variety of resources into number values (impact scores). These values allow direct comparisons of estimated impacts on those resources from the introduction of electric transmission facilities within alternative corridors. Both an estimate of the seriousness of the potential impact for each resource, as well as the relative importance of one resource as compared to another is incorporated. Additional features of this procedure include:

1) Simplicity. It can be easily understood and used. No computerization of data is required, although a computer could be employed to store data and perform calculations.

2) Adaptability. Either broad-level or site-specific analysis can be conducted. Various adjustments for specific situations (such as for existing parallel corridors) can be incorporated.

3) Flexibility. Nearly any level of information can be adapted for use. Data and information which are already available can be utilized, or results of studies to gain updated, detailed information can be used. Reliability of impact scores will be proportional to the quality of information incorporated.

4) Retention of resource identity. Results can be expressed not only as total impact scores (as an index to potential total impact), but also to display impact scores for each resource within each corridor segment.

This procedure can be used to evaluate potential environmental impacts for other corridor-related utilities.

ABSTRACT

A procedure was developed for evaluating potential environmental impacts of alternative electric transmission corridors for the federal Colstrip Transmission Study (Projects 3 and 4). This procedure is designed to convert expert mapped environmental information from a wide variety of resources into number values (impact ratings) which can be combined into comparisons of estimated impacts on these resources from the introduction of electric transmission facilities within alternative corridors. Both the magnitude of the seriousness of the potential impact for each resource, as well as the relative importance of one resource as compared to another is incorporated. Additional features of this procedure include:

1) Simplicity. It can be easily understood and used. No complex manipulation of data is required, although computer equipment could be used to store data and perform calculations.

2) Adaptability. Either broad-level or site-specific studies can be conducted. Various adjustments (for example, to account for existing parallel corridors) can be incorporated.

3) Flexibility. Readily available information can be used; any form and information which exist currently can be utilized, or results of studies to gain complete new information can be used. Reliability of results depends on the quality of information incorporated.

4) Retention of resource identity. Results can be expressed not only as total impact scores for each corridor segment, but also to display impact scores for each resource within each corridor segment.

This procedure can be used to evaluate potential environmental impacts for other corridor-related utilities.

INTRODUCTION

The Colstrip Transmission Study Project was an interagency effort which was conducted as prescribed in the Colstrip Work Management Plan and under the guidance of an interagency Steering Committee (USFS, BLM, BIA, and BPA). An interdisciplinary Study Team was organized to conduct the project. One task of the Study Team was to identify (or develop) the methodology which would allow for appropriate comparative evaluation of alternative transmission corridors so that a valid transmission Environmental Report could be derived as required by each agency.

This document sets forth the procedure developed by the interagency interdisciplinary Study Team and which was approved for the Colstrip transmission corridor analysis by the interagency Steering Committee. Results of the Transmission Environmental Report were then available for incorporation into the Federal Environmental Statement for the entire Colstrip project.

The Environmental Statement (ES) process involves primarily the analysis of potential impacts on various environmental resources. In the case of power transmission facilities, this impact analysis includes a study area which encompasses the generating source, the destination, and the interval area which includes all reasonable or feasible alternatives for routing the power corridor. This can be a very diverse area, depending on the length of the required transmission line and the nature of the regions crossed.

The Colstrip transmission project proposal (Westinghouse 1973) was to construct two parallel overhead 500-kV lines in a common right-of-way 300 feet wide and approximately 430 miles long between the Colstrip generating plants and Hot Springs, Montana (see Figure I-1). Here it would intertie with the Pacific Northwest power grid system. Impacts from a transmission project of this magnitude crossing a very diverse area are likely to be serious and important. The area of potential environmental influence, including all reasonable corridor alternatives, encompasses extreme diversity of physiography, vegetation, wildlife, and other physical resources as well as many social and economic variables.

Thus, the Study Team identifying the least-impact corridor was confronted with the task of evaluating the seriousness and importance of potential impacts on many resources, and across a wide range of conditions. A standard procedure for this type of environmental analysis has not been established.

The purpose of this monograph is to describe a procedure developed by the Federal Colstrip Transmission Corridor Study Team to evaluate alternative transmission corridors. The procedure was used to derive numerical values relating to an overall impact potential. Both <u>seriousness</u> of potential impacts and relative <u>importance</u> of impacts on each resource were incorporated. The resultant values (environmental impact scores) were used to make direct comparisons between alternative corridors that could serve the same purpose electrically between two common points. A uniform level of analysis was employed for all lands (Federal, State, and private) even though more detailed information was sometimes available for some portions of the study area as compared to others.

The interdisciplinary Study Team provides for a professional interpretation of environmental impacts with associated checks and balances. Thus, this procedure is presented as a basis for other studies of a similar nature. The corridor location decision could be aided by results from this type of analysis to help provide a more balanced environmental, economic, and engineering determination.

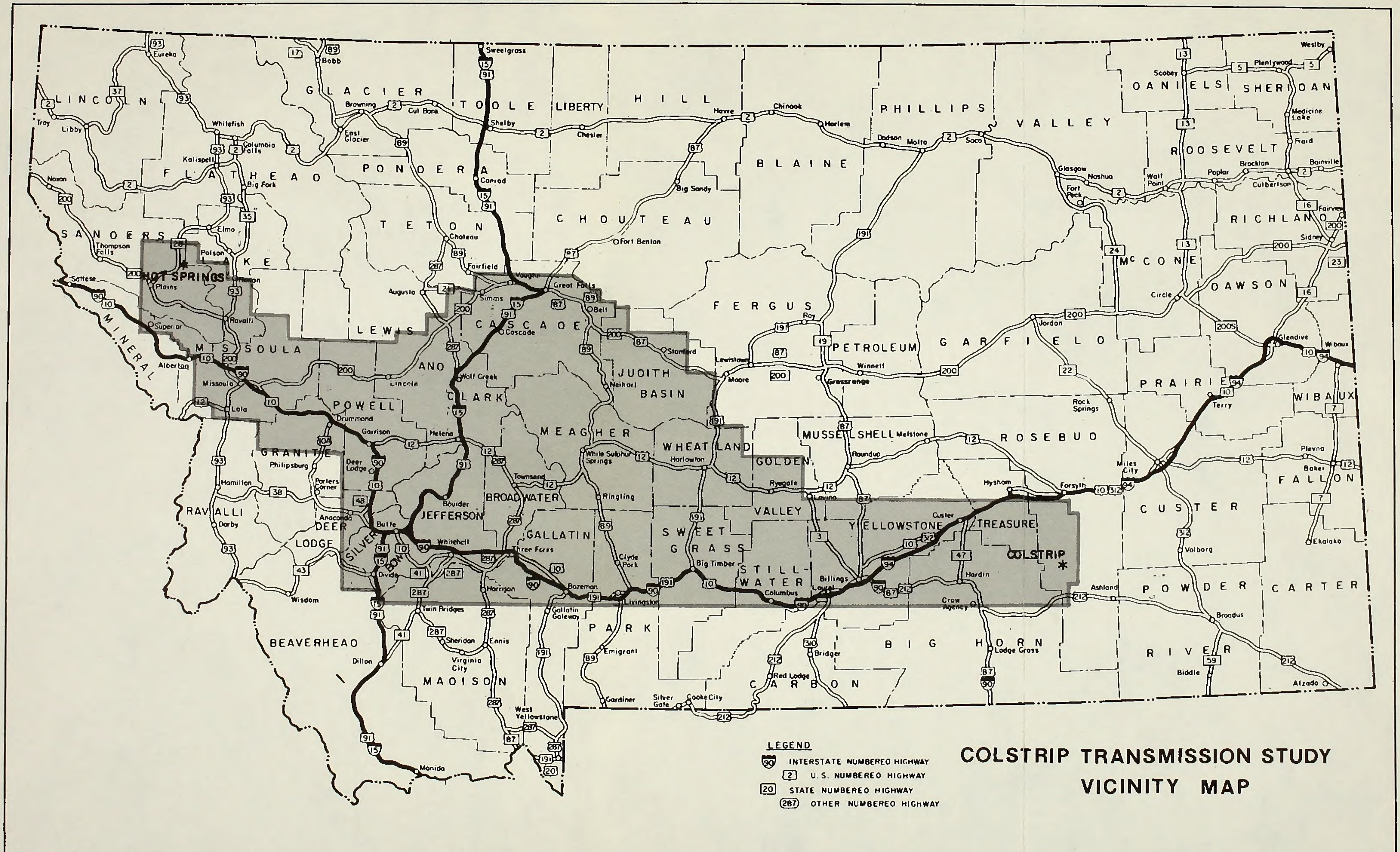
COLSTRIP TRANSMISSION STUDY
VICINITY MAP
LEGEND
INTERSTATE NUMBERED HIGHWAY
U.S. NUMBERED HIGHWAY
STATE NUMBERED HIGHWAY
OTHER NUMBERED HIGHWAY
HOT SPRINGS
COLSTRIP

Figure I-1

STUDY AREA BOUNDARIES

Boundaries around the area in which all reasonable transmission corridors can be located must be established. This area then becomes the "study area". Drawing lines to circumscribe the outer limits of the area is one approach used in many environment impact studies. If all resource data were available in the form of maps, this approach would be tenable. However, because most data are not in this form and they relate to entire political/cultural jurisdictions, it is not possible to discern the distribution of the data within the jurisdictional boundaries. Thus, if the political/cultural unit is dealt with in its entirety, rather than having only a portion of it in the study area, data use can be simplified. Also, additional data developed in this manner during the study will provide information which can be more readily used for other purposes.

County lines or boundaries of other land-use planning areas should be used where feasible and, as a minimum, township or section lines should be followed. Areas which obviously are not suitable due to land-use restrictions or physiographic features should be eliminated in this way, and the size of the study area can be minimized while maintaining the integrity of data within existing political/cultural units.

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BACKGROUND AND RATIONALE

A required feature of any method used to estimate potential impacts from construction and maintenance of transmission facilities is the identification of resources that may be subject to impacts. Several reports discuss this aspect of environmental analysis in general (Battelle 1971; Dicker 1974; Kitchings, et al. 1974; Leopold, et al. 1971; McHarg 1969; Sorensen 1971; Voytko 1972). To be of value to decision makers, the procedure should also allow an estimate of the seriousness of each potential impact and importance of impacts on each resource. Procedures which do this have been developed, but most of them result in a single index value which represents predicted total impacts (Battelle 1971; Institute of Ecology 1971; Kitchings, et al. 1974; Leopold, et al. 1971; Odum 1972; USDI 1976). The aggregation of environmental impacts into a single number index may not facilitate decision making if those responsible for the decision cannot readily discern the contribution of various resources to the number index. Complicated, expensive modelling procedures (environmental simulation using both mathematical and scale models) have also been developed (Appleyard and Craik 1974; Ayers and Kneese 1969). Use of complex model development for large scale environmental analysis requires a major investment in development of computer oriented study team capabilities and in collection, correlation, and quality control of baseline environmental data.

To be of practical value to a wide range of corridor related studies, a procedure should be reliable, easily understood by users, and provide a means of deriving values which not only allow comparison of overall impact potential, but also illustrate the contribution of each resource to the total impact potential within each corridor segment.

A basic problem inherent in all current methods is the scaling of values related to each resource. A Study Team's evaluation may or may not be a true representation of societal values. However, with proper subjective consideration of known public concerns, the Team's analysis must be relied upon in this or any other environmental analysis process if the procedure is to be useful.

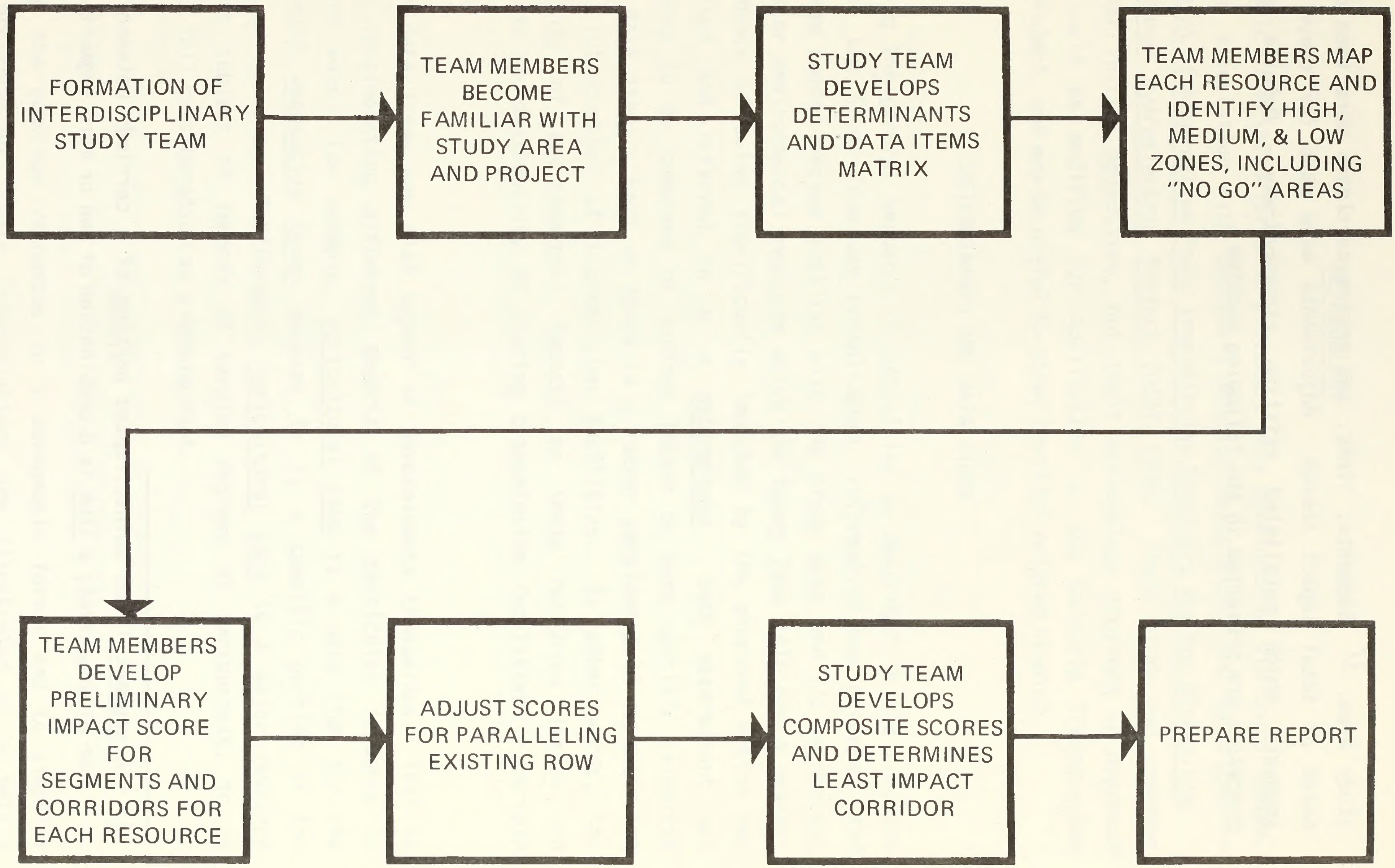
The Colstrip Transmission Study Project was conducted in the general sequences as illustrated in the flow chart of Figure 2. Following development of the project plan by agency personnel, the study team was organized. The Study Team should be carefully selected to include highly qualified professionals from each discipline which relates to major resources of the study area. Some required inputs may be provided through qualified consultants.

Team members must familiarize themselves with the study area, determining existing resources and the probability of impacts to each resource. To avoid unnecessary complexity, resources which will not be significantly influenced are excluded. All available information relating to resources identified as significant is then gathered. Other professionals are contacted and a broad base of data and information is developed. For certain resources, additional studies may be required, in which case they should be initiated as soon as possible.

Team interaction at this stage was then necessary to discuss important resources which would likely be impacted by construction and maintenance of the transmission facilities. In this methodology, resources were identified as "determinants" and "data items" as described in detail in the following section. Each resource was then mapped at a common scale and zones of different impact potential identified. The maps also indicate areas of no impact (where the particular resource does not exist) or where definite "no-go" situations occur. This process allows the Team to estimate the <u>seriousness</u> of potential impacts to the resources of the study area. The <u>importance</u> of impacts on each resource can also be addressed by scaling all resources; a procedure requiring serious attention by the entire team while considering the entire data base, including known public concerns.

The methodology was developed whereby the seriousness and importance of potential impacts to each resource were expressed as numerical analogs. Thus, an impact score was developed for each corridor segment within the

Figure 2 SEQUENCE OF ACTIVITIES FOR CORRIDOR ANALYSIS



study area. 1/ Segments, links, and entire corridors were then compared, based on total impact scores. Adjustments were made for those corridor segments which paralleled existing rights-of-way. Details of these processes are presented in the following section.

1/ - A segment is an uninterrupted portion of a corriodr between branches or alternatives; a link is a combination of two or more segments.

METHODOLOGY

Some basic principles for this procedure were developed by VTN Consolidated, Inc. in association with Comitta Frederick Associates, and described in Assessment of Alternative Power Transmission Corridors for the Dickey/Lincoln School Hydroelectric Project (USDI 1976). Their study had somewhat different initial objectives, but their methodology provided an approach which could be modified for application to the Colstrip Transmission Study Project, and may be useful to other corridor related studies.

DETERMINANTS AND DATA ITEMS

Following the general sequence of activities as described in the previous section, the Study Team was consolidated, information was gathered, and each Team member became familiar with the study area and its resources. Each major environmental resource which the Study Team felt had a reasonable chance of being significantly impacted by the proposed action was identified and referred to as a determinant. Each determinant was considered to be composed of various lesser or more specific resources termed data items. Each of these is a factor considered as a constraint to the introduction of transmission facilities. In other words, the possibility of environmental impacts on these resources limits the usefulness or desirability of placing transmission facilities in certain areas.

Certain data items may also appear as determinants themselves. This is due to incorporating different aspects of the particular resource in different ways. For example, Agricultural Land is a data item for the determinant Vegetative Cover because it is a specific portion of the vegetation resource. Furthermore, Agricultural Land is a major resource which is subject to impacts of varying degrees of seriousness, so it warrants full consideration as a determinant.

MATRIX

To keep the numerous resources in a manageable format and to simplify their presentation, their interrelations are illustrated as a matrix

(Figure V-2). Details on the significance of numbers and letters on this matrix are given below. Also, the composition and derivation of each determinant and data item in this matrix are described in corresponding sections of the Appendix. Some of these are simple (such as Agricultural Land) while others are rather complicated (such as Wildlife). In all cases, it is critical to this approach that the information and data from all resources be displayed in a similar manner so that the different levels of sensitivity to potential impact can be derived.

RESOURCE MAPS

The judicious assignment of numbers to resources (identified as determinants and data items), is combined with a basic unit (e.g., Human Population) or distance measurement across which the resource is impacted. This provides a basis for deriving comparative estimates of the severity of impact for each segment or alternative corridor.

For this approach to be used, the geographic distribution of each important resource within the study area must be known. Hence, a method of "mapping" each resource must be developed. Data and information which are mapped will show locations, distributions and concentration of resources, and thus, provide indications of sensitive areas. As mentioned before, data must be at a uniform level throughout the study area.

CORRIDOR LOCATIONS

Following the development of resource maps, they can be utilized to help establish potential corridor locations. The maps from all resources can be superimposed to show areas best suited for corridors as well as to indicate highly sensitive areas or areas of legislative restriction which obviously should be avoided. In this sense, sensitivity includes: (1) locations of "critical" resources which would likely be severely impacted; and (2) locations of coincident impacts to a number of resources. Having more than one resource which may be impacted in a given location increases the potential for environmental degradation. Thus, increased

Data Item Weights - H=4, M=2, L=1

DETERMINANTS	WEIGHTS	LAND SUITABILITY: Good	Fair	Poor	SURFACE WATER: Sediment Risk - High	Sediment Risk - Medium	Sediment Risk - Low	FISH AND WILDLIFE: High Impact Potential	Medium Impact Potential	Low Impact Potential	Threatened and Endangered Animal Species
FISH AND WILDLIFE	2							H	M	L	H
LAND SUITABILITY	2	L	M	H							
SURFACE WATER	1				H	M	L				
VEGETATIVE COVER	2										
UNIQUE NATURAL RESOURCES	3										
AGRICULTURAL LAND	2										
COMMERCIAL FOREST LAND	3										
RANGELAND	1										
RECREATION RESOURCES	2							M	L		
LAND MANAGEMENT PLANS	–										
PREHISTORIC & HISTORIC	2										
HUMAN POPULATION	2										
VISUAL RESOURCES	3										

DETERMINANTS	VEGETATION: Agriculture: Irrigated Land	Prime and Unique Farm Land	Dry Land Farming	Rangeland: Intermtn. Valley Grassland and Meadow	Foothill Sagebrush	Foothill Grassland	Northern Grassland	Teton River-Judith Basin Grassland	Central Grassland	Beartooth Juniper/Limber Pine	Riparian	Sandy Grassland
FISH AND WILDLIFE												
LAND SUITABILITY												
SURFACE WATER												
VEGETATIVE COVER	L	L	L	M	M	M	M	M	M	M	M	M
UNIQUE NATURAL RESOURCES												
AGRICULTURAL LAND	H	H	M									
COMMERCIAL FOREST LAND												
RANGELAND				L	M	L	L	M	L	M	L	M
RECREATION RESOURCES												
LAND MANAGEMENT PLANS												
PREHISTORIC & HISTORIC												
HUMAN POPULATION												
VISUAL RESOURCES												

DETERMINANTS	Forest Land: Larch/Douglas-fir	Lodgepole Pine/Douglas-fir	Western Montana Ponderosa Pine	Eastern Montana Ponderosa Pine	Ponderosa Pine Savannah	Wetlands	Threatened and Endangered Plant Species
FISH AND WILDLIFE						H	
LAND SUITABILITY							
SURFACE WATER						H	
VEGETATIVE COVER	H	H	H	H	H	H	H
UNIQUE NATURAL RESOURCES						H	H
AGRICULTURAL LAND							
COMMERCIAL FOREST LAND	H	M	H	M	L		
RANGELAND	L	L	H	H	M	H	
RECREATION RESOURCES						M	
LAND MANAGEMENT PLANS							
PREHISTORIC & HISTORIC							
HUMAN POPULATION							
VISUAL RESOURCES							

DETERMINANTS	SPECIALLY MANAGED AREAS: Wilderness/Primitive	New Wilderness Study Areas	Roadless Areas (Includeds Essentially Roadless)	Natural Areas (Pristine, Relict, Geologic, Scenic & Landmarks)	Game Refuges and Ranges	State Parks and Recreation Areas	Wild and Scenic Rivers	Scenic Travelways	Recreation Waterways	Management Objectives for Specified Areas
FISH AND WILDLIFE					H					
LAND SUITABILITY										
SURFACE WATER										
VEGETATIVE COVER										
UNIQUE NATURAL RESOURCES	H	H	L	H		M	H			
AGRICULTURAL LAND										
COMMERCIAL FOREST LAND										
RANGELAND										
RECREATION RESOURCES	H	H	H	H	H	H	H	H	H	
LAND MANAGEMENT PLANS										
PREHISTORIC & HISTORIC										
HUMAN POPULATION										
VISUAL RESOURCES										

DETERMINANTS	RECREATION SUITABILITY: High Impact Potential	Medium Impact Potential	Low Impact Potential	PREHISTORIC AND HISTORIC: High Sensitivity Zone	Medium Sensitivity Zone	Low Sensitivity Zone
FISH AND WILDLIFE						
LAND SUITABILITY						
SURFACE WATER						
VEGETATIVE COVER						
UNIQUE NATURAL RESOURCES						
AGRICULTURAL LAND						
COMMERCIAL FOREST LAND						
RANGELAND						
RECREATION RESOURCES	H	M	L			
LAND MANAGEMENT PLANS						
PREHISTORIC & HISTORIC				H	M	L
HUMAN POPULATION						
VISUAL RESOURCES						

DETERMINANTS	VISUAL: Scenic Quality: Distinctive	Common	Minimal	Visual Contrast: High	Medium	Low	Visual Management Classes: Preservation	Retention	Partial Retention	Modification	Maximum Modification
FISH AND WILDLIFE											
LAND SUITABILITY											
SURFACE WATER											
VEGETATIVE COVER											
UNIQUE NATURAL RESOURCES											
AGRICULTURAL LAND											
COMMERCIAL FOREST LAND											
RANGELAND											
RECREATION RESOURCES	H	M	L								
LAND MANAGEMENT PLANS											
PREHISTORIC & HISTORIC											
HUMAN POPULATION											
VISUAL RESOURCES				H	M	L	H	H	M	L	L

DETERMINANTS	POPULATION DENSITY AND PROXIMITY: <49 Persons Per Square Mile	5 – 49 Persons Per Square Mile	>5 Persons Per Square Mile	Pop. Ctr. Crossed by or within 1 Mi. of Corr.
FISH AND WILDLIFE				
LAND SUITABILITY				
SURFACE WATER				
VEGETATIVE COVER				
UNIQUE NATURAL RESOURCES				
AGRICULTURAL LAND				
COMMERCIAL FOREST LAND				
RANGELAND				
RECREATION RESOURCES				
LAND MANAGEMENT PLANS				
PREHISTORIC & HISTORIC				
HUMAN POPULATION	H	M	L	H
VISUAL RESOURCES				

CORRIDOR ANALYSIS AND EVALUATION MATRIX
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT

Figure V-2

sensitivity connotes increased probability that a large impact will occur in that area if transmission facilities are introduced.

To help locate alternative corridor options, aerial or ground reconnaissance and other means may be required. These corridors are then carefully mapped on the same base map as that employed for each resource map so they can be superimposed in subsequent steps in the analysis. It is important that all maps be developed at the same scale to allow the combining of impacts from various resources.

DISTANCE OF HIGH, MEDIUM, AND LOW AREAS CROSSED

Using the mapped resource data items, values (impact scores) are derived which relate to the sensitivity to potential impact for each resource. This is done by placing each data item into low, medium, or high categories, based on an interdisciplinary Team's estimate of the seriousness of the impact likely to occur on each data item. On the Colstrip project, the seriousness of each successively higher category was considered to be approximately twice as potentially detrimental in impact as the next lower category. Therefore, numerical analogs of 1, 2, and 4 were assigned to the low, medium, and high categories, respectively.

To illustrate this, consider the Vegetative Cover determinant. Vegetation is a known mappable resource of the study area which has a high probability of being impacted by the introduction of power transmission facilities. Comprising this determinant are the data items Agricultural Land, Rangeland, Forest Land, Threatened and Endangered Plant Species, and Wetlands. The Agricultural Land component of Vegetative Cover represents an already disturbed vegetation situation. It is a highly managed system and vegetative recovery would represent a minimal problem. Therefore, impacts on agricultural vegetative cover would not be very serious so it was assigned a low rating with an analog of 1. Rangeland vegetation is more sensitive to disruption of its natural condition and has related recoverability problems, so it was rated medium in seriousness of impact, or 2. Forest Land vegetation would be completely changed in most of the right-of-way ROW for as long as the corridor would be

maintained in service, so its sensitivity or seriousness rating is high with a corresponding number analog of 4. Likewise, any Threatened or Endangered Plant Species or Wetlands vegetation would be seriously impacted if disrupted by activities related to a power transmission corridor, so they were rated 4. Thus, each L, M, or H (low, medium, or high) symbol in the matrix (Fig. V-2) refers to the relative seriousness (or sensitivity) of impacts to each data item. When used in calculating the impact score, the analog (1, 2, or 4) represents this seriousness. It is applied to the impact formula as described later in the methodology.

A blackened area in the matrix indicates a resource which cannot be infringed upon by a power corridor due to conflicting land management plans. Where these resource data items exist (e.g., wilderness/primitive areas), corridors must be aligned to avoid them completely. If these data items were given a numeric score the seriousness of the impact would not be properly reflected.

The first step in converting mapped resource information to impact scores is to superimpose a corridor segment map over each data item map. The distance, in miles, of each corridor segment which coincides with or crosses mapped data items is measured and recorded. Each level of sensitivity (low, medium, and high) is measured separately, and results multiplied by their corresponding analog (1, 2, or 4, respectively). The sum of these values for each data item represents the data item impact score for the corridor segment being measured.

The selection of a unit of measurement is not important as long as it is used uniformly throughout the analysis. Differences in potential impact are expressed as percentages rather than absolute values. Using distance as a basis for impact estimates has the advantage of relating impacts to corridor or segment lengths or distances of specific resources crossed. (Note: a segment is an uninterrupted portion of a corridor between branches or alternatives; a link is a combination of two or more segments.) This helps to account for greater potential impacts on longer segments, thus favoring shorter routes if no difference in sensitivity exists between segments. However, only those determinants which

are continuous over all land areas (such as Land Suitability or Visual Resources) exhibit this advantage. Other determinants (such as Agricultural Land and Commercial Forest Land) are discontinuous and the area covered by these is not necessarily related to segment length. Still other determinants relate to point or number data (e.g., Prehistoric and Historic Sites and Human Population) and required special development.

An additional advantage of estimating impacts in relation to distance is that a value for total impact score per mile (or other distance unit) of segment can be calculated. The magnitude of this value provides an indication of the suitability of various areas for power transmission facilities. In certain instances, longer segments may be preferred if they avoid areas crossed by shorter segments that have particularly high impact scores per mile of segment.

Details of how each data item and determinant was handled in the Colstrip project to derive the low, medium, and high impact categories are presented in the Appendix. Due to the variety of resources included in the analysis, much variation in the development process was required. Some determinants represent a single identifiable resource (e.g., Agricultural Land) while others (such as Wildlife) are composed of a variety of resources. Adaptation of this procedure for studies in other areas would require appropriate alterations and refinements to account for the specific resources of the study area.

WEIGHT RESOURCES FOR IMPORTANCE

One additional quantitative adjustment is required to make this procedure viable. A weighting of determinants is necessary to account for relative importance of impacts connected with different resources. This adjustment is made by assigning a value of 1, 2, or 3 (or other value if deemed appropriate) to each determinant and multiplying the data item impact score for each determinant by its appropriate value. Thus, both the seriousness of potential impacts, plus the relative importance of that resource impact are accounted for in the analysis. Discussion of how each determinant was weighted in the Colstrip project is presented with the description of determinants in that section of the Appendix. Again,

if the quality of data and information warrant it, a different range of comparative importance values may be utilized for a particular study.

CALCULATE IMPACT SCORES

Derivation of the impact score for each resource (determinant) can be visualized as a multiplicative combination of distance, seriousness of potential impact, and importance of that resource impact, as follows:

$$\begin{bmatrix}\text{Distance of}\\\text{Impact Effect}\end{bmatrix} \times \begin{bmatrix}\text{Seriousness}\\\text{of Impact}\end{bmatrix} \times \begin{bmatrix}\text{Importance}\\\text{of Resource}\\\text{Impact}\end{bmatrix} = \begin{matrix}\text{Resource Impact}\\\text{Score for Segment}\end{matrix}$$

The sum of all resource impact scores for a segment is the <u>total segment impact score</u>.

Substituting the analogs to derive a number value provides the following formula for calculating impact scores:

$$\left[\begin{matrix}\text{Mi of High}\\\text{Data Items}\end{matrix} \times 4\right] + \left[\begin{matrix}\text{Mi of Medium}\\\text{Data Items}\end{matrix} \times 2\right] + \left[\begin{matrix}\text{Mi of Low}\\\text{Data Items}\end{matrix} \times 1\right] = \begin{matrix}\text{Data Item}\\\text{Impact Score}\end{matrix}$$

and:

$$\begin{bmatrix}\text{Data Item}\\\text{Impact Score}\end{bmatrix} \times \begin{bmatrix}\text{Determinant Weight}\\\text{Factor (1, 2, or 3)}\end{bmatrix} = \begin{matrix}\text{Determinent Segment}\\\text{Impact Score}\end{matrix}$$

and, finally:

$$\begin{matrix}\text{Sum of }\underline{\text{All}}\text{ Determinant}\\\text{Segment Impact Scores}\end{matrix} = \text{Total Segment Impact Score}$$

To simplify manipulations of the large number of values which will be derived during the analysis, decisions should be made concerning the number of significant digits warranted by the data so that scores from various resources can be easily combined. Using a computer to store

data and perform calculations will reduce the chance of computational errors, but this phase can be conducted manually. Care must be taken to eliminate errors and values should all be thoroughly checked.

ADJUST FOR PARALLEL ADVANTAGE

An additional adjustment in impact scores should be made if any alternative corridor segments have existing power lines. This may be considered as an additional determinant (the Parallel Advantage determinant), but unlike other determinants its existence decreases potential environmental impacts because a power line has already been introducted onto the landscape. The following methodology was developed whereby segment impact scores are reduced in accordance with the size, number, and length of existing parallel lines.

For the Federal Colstrip Transmission Corridor Study Project, the Parallel Advantage determinant is composed of six data items. Each one is a combination of number and size of existing power lines in the corridor and the forested or non-forested condition of the landscape (see Table 1). Each of these data items was evaluated for the advantage (reduction of impact potential) it represents to the various resource determinants. Only 9 of the 13 determinants were thought to be significantly benefitted from an existing line, so not all determinants are represented in this table. The advantage of paralleling existing power lines was rated as 1 (slighty advantageous), 2 (moderately advantageous), or 4 (highly advantageous), within each of the resource determinants. These ratings were multiplied by the determinant value (see Fig. V-2) to obtain a weighted rating for each determinant. The sum of all weighted ratings across all determinants was divided by the number of determinants involved to yield a mean weighted data item value. These values are given in the bottom line of Table 1.

To use these values to adjust impact scores, each mean weighted data item value is multiplied by the number of miles that data item occurs along each segment. Resultant parallel advantage data item scores were summed across all data items to provide a determinant score. This determinant score from each segment was substracted from the total score

Table 1 - THE "PARALLEL ADVANTAGE" DETERMINANT

	Existing Corridors Paralleled (Data Items) 3/					
	Forested			Nonforested		
Determinant 1/	<230kV	230kV	230kV+ 2/	<230kV	230kV	230kV+ 2/
Fish and Wildlife (2)	2 (4)	2 (4)	4 (8)	1 (2)	1 (2)	1 (2)
Land Suitability (2)	2 (4)	2 (4)	2 (4)	2 (4)	2 (4)	2 (4)
Surface Water (1)	2 (2)	2 (2)	2 (2)	1 (1)	1 (1)	1 (1)
Vegetation Cover (2)	1 (2)	1 (2)	1 (2)	-	-	-
Commercial Forest Land (3)	1 (3)	2 (6)	4 (12)	-	-	-
Rangeland (1)	-	-	-	1 (1)	1 (1)	1 (1)
Recreation Resources (2)	1 (2)	2 (4)	4 (8)	1 (2)	2 (4)	4 (8)
Prehistoric and Historic (2)	1 (2)	2 (4)	4 (8)	1 (2)	2 (4)	4 (8)
Visual Resources (3)	1 (3)	1 (3)	2 (6)	2 (6)	4 (12)	4 (12)
	(22)	(29)	(50)	(18)	(28)	(36)
Weighted	2.8	3.6	6.2	2.6	4.0	5.1

1/ - Includes only determinants that would benefit by paralleling existing rights-of- way. Determinant weights are in parenthesis.

2/ - 230kV+ = one 230kV line plus 1 or more smaller lines.

3/ - Left column shows Data Item Value: 1-slightly advantageous, 2-moderately advantageous, or 4-highly advantageous. Right column (in parenthesis) shows weighted ratings: Determinant Value X Data Item Value.

for that segment, yielding reduced impact scores which reflect the influence of parallel existing lines.

The derivation of this determinant and its application can be summarized as follows:

1. [Data Item Value] x [Determinant Value from Fig. V-2] = Weighted Determinant Value

2. [Sum of Weighted Determinant Value] ÷ [Number of Determinants] = Mean Weighted Data Item Value

3. [Mean Weighted Data Item Value] x [Miles of Line of Each Data Item Type] = Data Item Score for that Line Type

4. Sum of all Data Item Scores Across All Line Types = Determinant Score for Parallel Advantage

5. [Total Impact Score] - [Determinant Score for Parallel Advantage] = Adjusted Impact Score

An example of how this determinant influenced segment and corridor impact scores is included in Tables 3 and 4. Impact score adjustments ranged from 3 to 9 percent of the total unadjusted scores. Greater weight for <u>Parallel Advantage</u> would be justified if larger lines than those in this analysis were present. However, two 500-kV transmission lines represent an overwhelming effect as compared to any of these smaller existing lines, and the amount of ROW clearing and access road reconstruction required obviates some of the advantage of paralleling existing corridors. Others using this method should be certain that adjustments made will reflect that Study Team's estimate of the actual impact reduction to be expected.

COMPARE SEGMENTS, LINKS AND CORRIDORS

Once a total segment impact score is derived for each corridor segment within a study area, direct comparison can be made between any two

segments or links which serve to connect any two common points on a proposed corridor (i.e., links are combinations of two or more segments, and link scores are merely a summation of segment scores which compose the link). Segments or links with the highest total impact scores would be least desirable because they would cause the most degradation of the study area's environment. Segments with higher impact scores should be avoided in favor of segments with lower impact scores.

Any combination of segments, including entire corridor lengths, can be compared in this manner as long as all corridors (or links or segments) being compared serve the same two end points. They need not be the same length, because distance is used as a basic unit in deriving the impact score. It is possible for a longer segment, as a result of crossing less environmentally sensitive areas, to be preferred over a shorter one.

Evaluation of difference in potential impact is based on percentage difference in impact scores. No precise figure for difference between segment impact scores can be specified which will definitely indicate the existence of a real difference in resulting impact. This will depend largely on the quality of data and information used to refine the resource maps, map scale employed, precision of distance measurements, and other factors which can create uncertainties in the impact scores. Persons conducting the study will need to develop a "feel" for this as the study progresses. The Colstrip Transmission Study Team felt that the difference between impact scores of segments being compared must be 5% or more to indicate a significant difference. Differences less than this suggest that comparative impact scores are of little value for selecting the preferred segment. Enlarging the scale for small areas should result in greater precision than this, while reduced scales for even larger projects may require greater percentage differences to help identify preferred corridors.

Even where impact scores do indicate that large differences in suitability exist, they can serve only as a primary guide to the final decision. Other factors, such as the number of determinant impact scores which favored each segment can indicate a preference. The procedure allows

had the greatest influence in creating differences in impact scores. If total segment impact scores are within 5% (or the selected difference) of each other, and all other factors are more or less equal, the most direct route would be preferred due to economic considerations. A direct comparison of certain quantifiable impacts may be necessary for managerial decisions where impact scores are essentially equal.

EXAMPLE OF RESULTS

The following material is presented to provide an example of each step of this methodology. The examples are taken from the Colstrip Transmission Environmental Report (1978), and for complete details this report should be studied. This methodology was employed in that study to: (1) eliminate a large number of potential corridor segments which had been generated in previous studies (Westinghouse 1973; Montana 1974); (2) comparatively evaluate remaining segments and entire corridors; and (3) help generate new segments to avoid specific problem areas. These new segments and associated corridors were then also evaluated by this procedure.

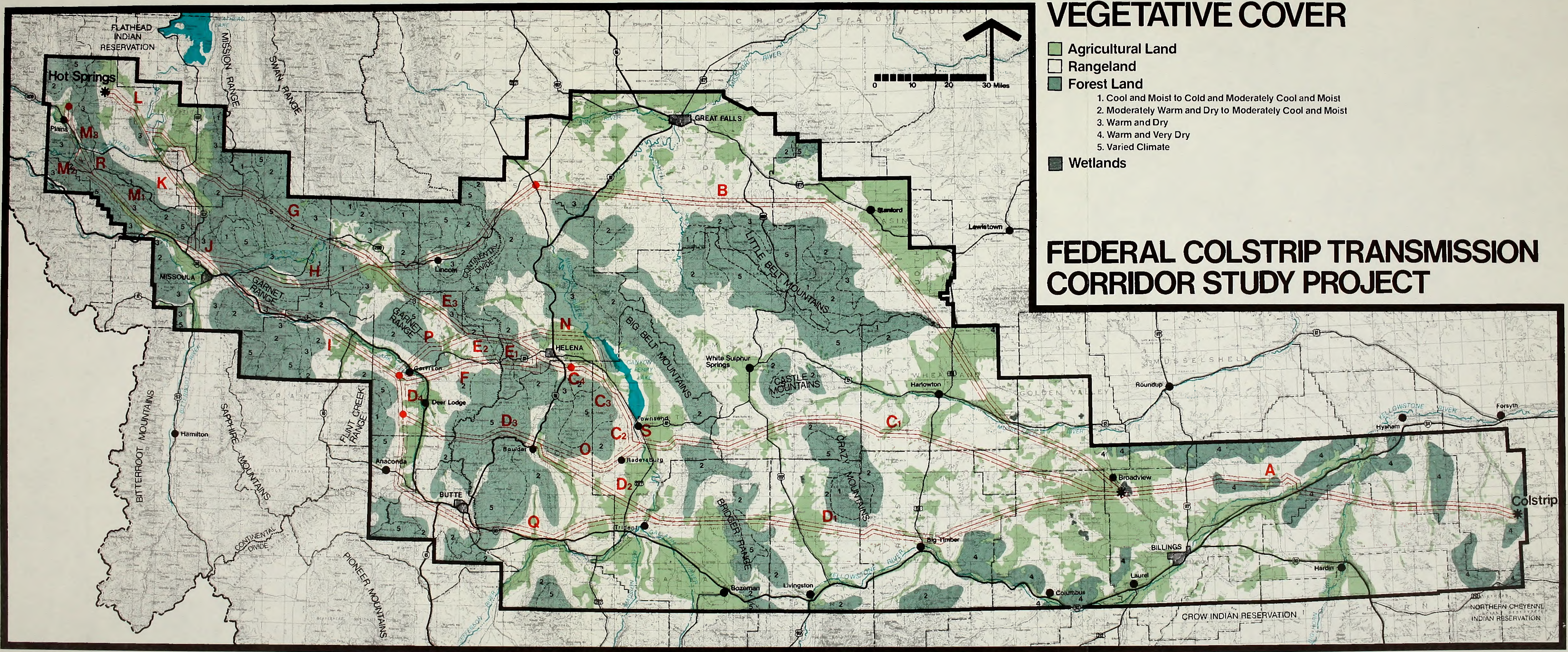
The resource determinant-data item map for Vegetative Cover (see Figure IV-5) is provided as an example of the first required step in the methodology. Each resource must be converted into a map showing appropriate levels of sensitivity to impact, or potential impact seriousness. Then, a corridor segment map is superimposed over each of these resource maps and the distance of each segment which crosses each sensitivity level is measured and recorded. Table 2 is an example of these values for Vegetative Cover, showing appropriate multiplication for the corresponding level of impact seriousness (1, 2, or 4 for low, medium, or high, respectively). This provides the determinant impact score for each corridor segment. A corridor impact map (Fig. VII-3) can be developed to illustrate areas of various impacts.

Next, similarly derived impact scores for each determinant are summed to provide the total impact score for each segment. An example of this is illustrated in Table 3, Column 16. The impact score per mile of segment is calculated as shown in Column 17 of Table 3. The impact score adjustment for the Parallel Advantage determinant is made to derive the adjusted segment impact score (Column 19). This is the best overall estimate of potential environmental impacts for each segment, and it is used to compare alternate segments or links to determine those with least impact. Numerous paired comparisons may be required to identify the least-impact segment.

Alternative corridors are compared by combining the impact scores for all segments composing the corridor. Results of this step are illustrated in Table 4. In this example, the applicant's proposed corridor was used as the base for comparison to evaluate percent difference in impact score between it and all other alternative corridors.

Supplemental quantitative information (such as that illustrated in Table 5) can also be included. These data can be used to help make environmental decisions when impact score differences are negligible.

Finally, a corridor impact map can be developed to illustrate the coincidence of high impacts (also medium and low, if desired) within each corridor. Figure I-3 is an example of such a map for coincidence of high impacts. The western, mountainious portion of this study area emenates as a region generally more sensitive to the introduction of the power corridor than does the eastern portion. Also, segments of high sensitivity to combined resource impacts can be readily discerned on this map.



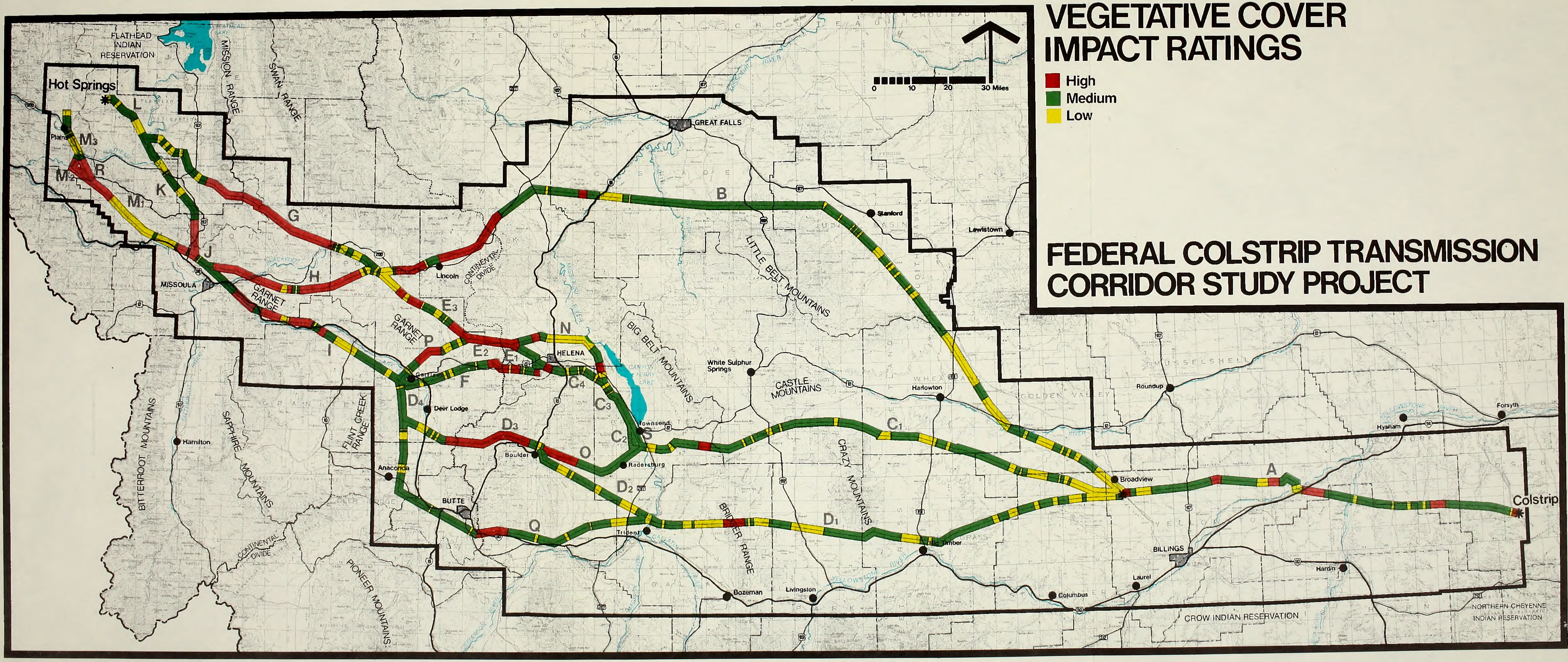
VEGETATIVE COVER
Agricultural Land
Rangeland
Forest Land
1. Cool and Moist to Cold and Moderately Cool and Moist
2. Moderately Warm and Dry to Moderately Cool and Moist
3. Warm and Dry
4. Warm and Very Dry
5. Varied Climate
Wetlands
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
0 10 20 30 Miles
Hot Springs
Plains
FLATHEAD INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
GREAT FALLS
Stanford
Lewistown
LITTLE BELT MOUNTAINS
Lincoln
CONTINENTAL DIVIDE
MISSOULA
GARNET RANGE
HELENA
BIG BELT MOUNTAINS
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
Roundup
Forsyth
Hysham
Broadview
Colstrip
Garrison
Deer Lodge
Townsend
Radersburg
Boulder
Anaconda
BUTTE
Trident
Bozeman
Livingston
Big Timber
Columbus
Laurel
BILLINGS
Hardin
BRIDGER RANGE
CRAZY MOUNTAINS
Hamilton
BITTERROOT MOUNTAINS
SAPPHIRE MOUNTAINS
FLINT CREEK RANGE
PIONEER MOUNTAINS
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
A
B
C1
C2
C3
C4
D1
D2
D3
D4
E1
E2
E3
F
G
H
I
J
K
L
M1
M2
M3
N
O
P
Q
R
S

Figure IV-5

Table 2 - DERIVATION OF VEGETATIVE COVER DATA ITEM AND DETERMINANT SCORES FOR EACH CORRIDOR SEGMENT BASED ON MILES OF EACH DATA ITEM CROSSED.

	LENGTH	AGRICULTURAL LAND	RANGELAND	FOREST LAND	WETLANDS	AGRICULTURAL LAND (x1)	RANGELAND (x2)	FOREST LAND (x4)	WETLANDS (x4)	VEGETATIVE COVER Total 1/	DETERMINANT SCORE (x2)
	- - - - - - - - - - - - miles - - - - - -					- - Data Item Score - -					
A	111.4	13.0	79.3	16.3	2.8	13	159	65	11	248	496
B	241.8	75.0	132.7	34.1	-	75	266	136	-	477	954
C_1	134.2	47.0	84.1	3.1	-	47	168	12	-	228	456
C_2	7.0	1.0	6.0	-	-	1	12	-	-	13	26
C_3	13.2	2.0	11.2	-	-	2	22	-	-	24	48
C_4	20.1	1.0	17.5	1.6	-	1	35	6	-	42	84
D_1	130.7	55.0	69.7	6.0	-	55	139	24	-	218	436
D_2	35.7	19.0	16.7	-	-	19	33	-	-	52	104
D_3	39.2	5.0	10.5	23.7	-	5	21	95	-	121	242
D_4	10.7	2.0	8.7	-	-	2	17	-	-	19	38
E_1	8.3	2.0	4.8	1.5	-	2	10	6	-	18	36
E_2	11.2	-	-	11.2	-	-	-	45	-	45	90
E_3	32.5	11.0	7.7	13.8	-	11	15	55	-	81	162
F	42.7	6.0	28.5	8.2	-	6	57	33	-	96	192
G	78.3	20.0	14.0	44.3	-	20	28	177	-	225	450
H	48.5	7.0	4.4	37.1	-	7	9	148	-	164	328
I	61.2	9.0	41.8	10.4	-	9	84	42	-	134	268
J	4.7	1.0	2.6	1.1	-	1	5	4	-	11	22
K	35.7	11.0	15.6	9.1	-	11	31	36	-	79	158
L	16.1	7.0	9.1	-	-	7	18	-	-	25	50
M_1	36.6	20.0	2.4	14.2	-	20	5	57	-	81	162
M_2	9.3	-	0.8	8.5	-	-	2	34	-	36	72
M_3	11.3	10.0	1.3	-	-	10	3	-	-	13	26
N	32.2	19.0	10.1	3.1	-	19	20	12	-	52	104
O	30.0	1.0	19.2	9.8	-	1	38	39	-	79	158
P	23.6	4.0	10.6	9.0	-	4	21	36	-	61	122
Q	90.7	25.0	58.6	7.1	-	25	117	28	-	171	342
R	8.3	-	2.1	6.2	-	-	4	25	-	29	58
S	6.0	-	6.0	-	-	-	12	-	-	12	24

1/ - Values may be off by 1 due to rounding of numbers.



VEGETATIVE COVER IMPACT RATINGS
High
Medium
Low
0
10
20
30 Miles
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
Hot Springs
Colstrip
GREAT FALLS
HELENA
MISSOULA
BUTTE
BILLINGS
Lincoln
Stanford
Lewistown
White Sulphur Springs
Harlowton
Roundup
Forsyth
Hysham
Broadview
Townsend
Radersburg
Boulder
Deer Lodge
Anaconda
Hamilton
Trident
Big Timber
Bozeman
Livingston
Columbus
Laurel
Hardin
FLATHEAD INDIAN RESERVATION
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
GARNET RANGE
CONTINENTAL DIVIDE
BIG BELT MOUNTAINS
LITTLE BELT MOUNTAINS
CASTLE MOUNTAINS
CRAZY MOUNTAINS
BRIDGER RANGE
FLINT CREEK RANGE
SAPPHIRE MOUNTAINS
BITTERROOT MOUNTAINS
PIONEER MOUNTAINS

Figure VII-3

Table 3 - CORRIDOR SEGMENT ANALYSIS AND EVALUATION

		DETERMINANTS																	
		NATURAL					ECONOMIC			SOCIAL				VISUAL					
CORRIDOR SEGMENT	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATION RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	IMPACT SCORE PER MILE	SCORE ADJUSTMENTS FOR PARALLELING RIGHTS-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED PER MILE IMPACT SCORE
A	111.4	284	334	168	496	33	56	81	200	376	-	339	256	665	3288	29.5	-439	2849	25.6
B	241.8	854	768	358	954	6	324	324	424	1107	**	546	558	1492	7715	31.9	-662	7053	29.2
C_1	134.2	304	482	234	456	6	208	18	165	580	*	306	280	933	3972	29.6	0	3972	29.6
C_2	7.0	14	28	14	26	0	8	0	14	56	*	30	14	72	276	39.4	-4	272	38.9
C_3	13.2	26	42	21	48	0	8	0	19	16	-	75	26	79	360	27.3	-34	326	24.7
C_4	20.1	48	104	52	84	0	4	9	20	110	C	94	112	172	809	40.3	-32	777	38.7
D_1	130.7	302	458	222	436	3	252	36	194	541	**	304	284	919	3951	30.2	-201	3750	28.7
D_2	35.7	72	100	48	104	0	88	0	65	102	-	102	89	207	977	27.3	-5	972	27.2
D_3	39.2	172	178	86	242	0	28	141	39	165	C	88	111	316	1566	40.0	0	1566	40.0
D_4	10.7	36	22	11	38	0	12	0	11	21	-	25	21	64	261	24.4	-54	207	19.3
E_1	8.3	18	30	15	35	0	8	9	8	66	-	21	17	82	309	37.2	0	309	37.2
E_2	11.2	22	44	14	90	0	0	68	11	90	-	26	25	116	506	45.2	0	506	45.2
E_3	32.5	108	84	33	163	0	76	118	50	221	-	139	65	270	1327	40.8	0	1327	40.8
F	42.7	124	170	79	192	39	44	48	43	342	**C	125	146	358	1710	40.1	0	1710	40.1
G	78.3	402	270	85	450	0	96	471	122	547	*#	183	234	736	3596	45.9	-295	3301	42.2
H	48.5	270	168	49	328	54	40	408	116	254	##	119	133	505	2444	50.4	-53	2391	49.3
I	61.2	278	196	61	268	0	48	93	93	308	-	180	244	385	2154	35.2	-323	1831	29.9
J	4.7	16	18	5	22	0	8	12	5	38	-	11	19	28	182	38.7	-25	157	33.4
K	35.7	88	102	36	158	0	60	108	36	149	-	103	149	245	1234	34.5	-165	1069	30.0
L	16.1	32	56	16	50	0	36	0	16	48	-	92	46	82	474	29.4	-64	410	25.5
M_1	36.6	212	88	37	162	0	136	171	92	180	C	113	121	265	1577	43.4	0	1577	43.4
M_2	9.3	52	48	12	72	0	0	102	37	37	#	34	37	112	543	58.4	0	543	58.4
M_3	11.3	52	32	13	26	0	44	0	45	73	-	25	55	105	470	41.6	0	470	41.6
N	32.2	76	88	44	104	0	88	30	32	243	*	104	185	191	1185	36.8	0	1185	36.8
O	30.0	136	112	57	158	0	8	60	44	120	-	74	69	258	1096	36.5	0	1096	36.5
P	23.6	48	72	24	122	0	28	96	56	126	-	79	61	150	862	36.5	0	862	36.5
Q	90.7	222	294	135	342	0	124	42	153	403	-	221	337	633	2906	32.0	-223	2683	29.6
R	8.3	30	42	12	58	9	0	75	33	66	#	27	17	100	469	56.5	0	469	56.5
S	6.0	12	24	12	24	0	0	0	12	48	-	24	12	48	216	36.0	-1	215	35.8

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table 4 - CORRIDOR ANALYSIS AND EVALUATION

		DETERMINANTS																					
		NATURAL					ECONOMIC			SOCIAL				VISUAL									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
CORRIDORS	LENGTH (in miles)	FISH AND WILDLIFE	LAND SUITABILITY	SURFACE WATER	VEGETATIVE COVER	UNIQUE NATURAL RESOURCES	AGRICULTURAL LANDS	COMMERCIAL FOREST LAND	RANGELAND	RECREATION RESOURCES	LAND MANAGEMENT PLANS 1/	PREHISTORIC AND HISTORIC	HUMAN POPULATION	VISUAL RESOURCES	TOTAL IMPACT SCORE	TOTAL SCORE PERCENT DIFFERENCE FROM APPLICANT'S	IMPACT SCORE PER MILE	PER MILE SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	SCORE ADJUSTMENTS FOR PARALLELING EXISTING RIGHTS-OF-WAY	ADJUSTED IMPACT SCORE	ADJUSTED SCORE PERCENT DIFFERENCE FROM APPLICANT'S PROPOSAL	ADJUSTED PER MILE IMPACT SCORE	ADJUSTED PER MILE SCORE PERCENT DIFFERENCE FROM APPLICANT'S
APPLICANT'S PROPOSED	431.3	1256	1470	650	1896	39	492	774	623	2102	** #C	1299	1073	3183	14857	0	34.4	0	-865	13992	0	32.4	0
SIEGEL PASS	446.3	1402	1492	665	1992	102	588	969	776	2118	CC* ###	1319	1138	3368	15929	+7%	35.7	+3%	-584	15345	+10%	34.4	+6%
GREAT FALLS	447.6	1572	1428	627	1950	39	512	876	762	2078	** *#	1160	1094	2975	15073	+1%	33.7	-2%	-1460	13613	- 2%	30.4	-7%
HELENA (MACDONALD PASS)	445.3	1212	1528	684	1798	78	472	369	609	2015	CC ***	1349	1290	2995	14399	-3%	32.3	-7%	-1083	13316	- 5%	29.9	-8%
HELENA (AVON VALLEY)	445.7	1176	1504	658	1853	39	464	494	641	1955	*C	1350	1247	2985	14366	-3%	32.2	-7%	-1083	13283	- 5%	29.7	-9%
TOWNSEND-BOULDER	443.2	1346	1500	674	1888	39	464	513	609	1805	*C	1218	1195	2976	14227	-5%	32.1	-7%	-1070	13157	- 6%	29.7	-9%
TRIDENT-BOULDER	445.4	1280	1464	653	1814	36	588	471	659	1748	C **	1244	1219	2911	14085	-5%	31.6	-9%	-1276	12809	- 9%	28.8	-13%
BUTTE-ANACONDA	461.2	1258	1480	654	1810	36	596	372	708	1884	**	1275	1356	3021	14450	-3%	31.3	-10%	-1494	12956	- 8%	28.1	-15%

1/ Symbols are as follows (number of times each symbol is used corresponds to number of times that problem is encountered):

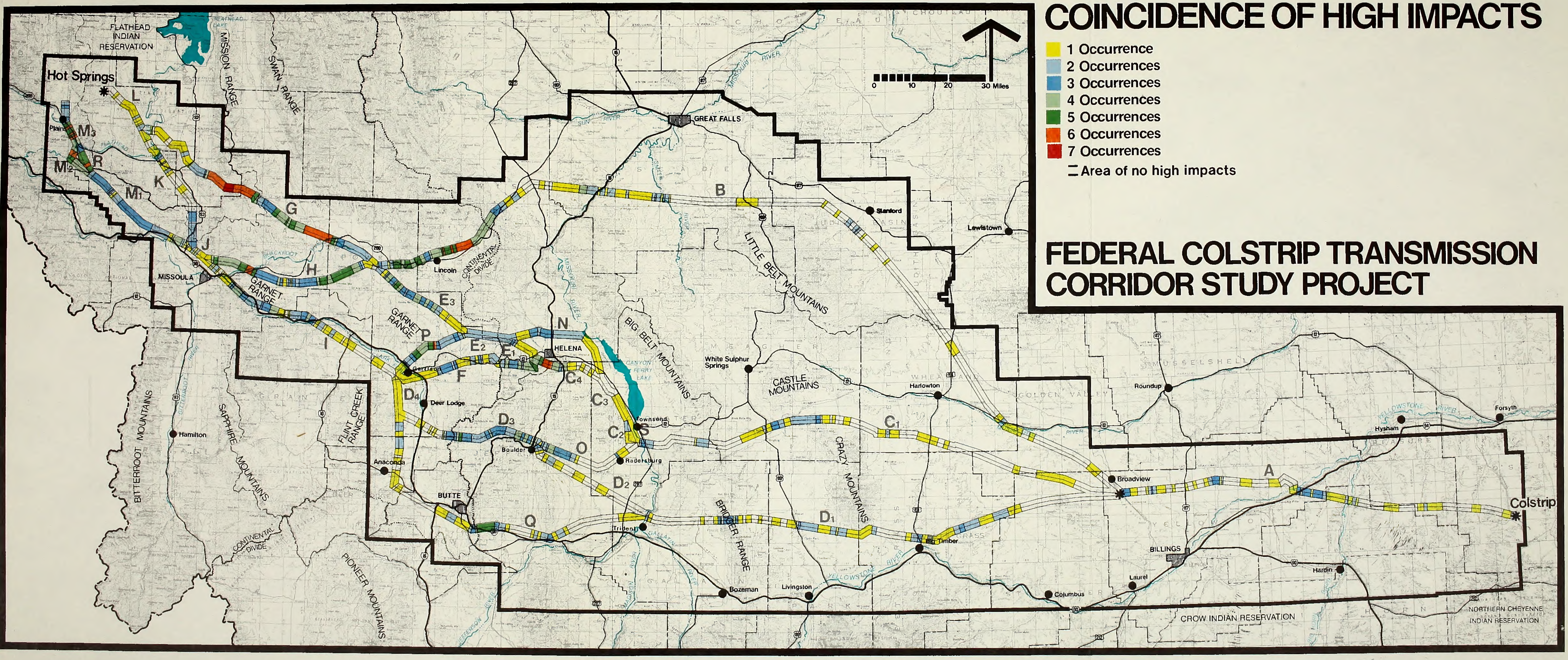
* - Potential conflict could be avoided during centerline location
# - Serious conflict; corridor relocation would be necessary
C - Conflict with management goals or objectives

Table 5 - CORRIDOR SUPPLEMENTAL QUANTITATIVE INFORMATION

CORRIDORS	1 LENGTH (in miles)	2 FEDERAL LANDS (miles)	3 INDIAN RESERVATION LANDS (miles)	4 STATE AND PRIVATE LANDS (miles)	5 TOTAL FOREST LAND CUT (acres, includes R-O-W and roads)	6 VOLUME OF TIMBER REMOVED (MCF, includes R-O-W and roads)	7 AGRICULTURAL LAND/IRRIGATED LAND (acres removed from production)	8 RANGELAND REMOVED FROM FORAGE PRODUCTION (acres/AUM's)	9 HIGH SEDIMENT RISK (miles)	10 POOR SUITABILITY FOR TRANSMISSION LINES (miles)	11 EXISTING R-O-W PARALLELED* (miles)	12 WATER BODIES/CLASS I & II FISHING STREAMS (# crossed)	13 RECREATIONAL WATERWAYS (# crossed/miles paralleled**)	14 STATE PARKS AND RECREATIONAL AREAS (existing/proposed)	15 SCENIC TRAVELWAYS (# crossed/miles paralleled**)	16 HISTORIC TRAILS (# crossed/miles paralleled**)	17 NATIONAL REGISTER & HISTORIC SITES	18 ELK WINTER RANGE/KEY ELK AREAS (miles of forested land)	19 MULE DEER, AND WHITE-TAILED DEER (miles of key forested area)	20 PROPOSED GRIZZLEY BEAR CRITICAL HABITAT (miles)
APPLICANT'S PROPOSED	431.3	49.4	55.4	326.5	3919	7771	271/5.1	1008/304	10	17	232/37	187/1	110/196	32/41	60/168	3/23	27	12/1	5	15
SIEGEL PASS	446.3	76.1	0	370.2	4538	9258	268/9.0	1098/282	10	15	161/41	195/2	81/169	27/36	58/180	3/30	29	21/3	3	0
GREAT FALLS	447.6	27.9	55.4	365.0	4045	8013	330/3.4	1050/307	3	10	366/3	261/0	91/175	39/32	59/112	2/0	10	10/0	5	32
HELENA (MACDONALD PASS)	445.3	38.6	48.3	358.4	2097	3769	249/5.5	1029/336	21	21	255/130	193/2	75/190	31/54	70/169	4/49	29	7/1	3	0
HELENA (AVON VALLEY)	445.7	39.4	48.3	358.0	2684	4948	254/5.0	1029/326	10	10	255/128	195/2	77/179	29/51	65/159	4/30	43	1/1	2	0
TOWNSEND-BOULDER	443.2	52.2	48.3	342.7	3126	6044	250/5.3	1038/296	15	14	240/92	208/2	77/185	28/39	66/121	1/20	10	14/12	2	0
TRIDENT-BOULDER	445.4	36.2	48.3	360.9	2826	5613	318/6.5	1043/332	12	13	319/92	227/2	78/231	24/43	68/165	1/4	9	7/12	3	0
BUTTE-ANACONDA	461.2	29.9	48.3	383.0	2106	4072	318/6.8	1073/356	5	6	379/144	231/2	79/213	21/45	69/158	1/4	10	5/0	3	0

* The first number refers to 100-kV and above powerlines. The second number refers to fossil fuel pipelines.

** Paralleling is measured if within 3 miles of the corridor center.



COINCIDENCE OF HIGH IMPACTS
1 Occurrence
2 Occurrences
3 Occurrences
4 Occurrences
5 Occurrences
6 Occurrences
7 Occurrences
Area of no high impacts
FEDERAL COLSTRIP TRANSMISSION CORRIDOR STUDY PROJECT
0 10 20 30 Miles
Hot Springs
FLATHEAD INDIAN RESERVATION
MISSION RANGE
SWAN RANGE
GREAT FALLS
MISSOULA
GARNET RANGE
HELENA
Lincoln
CONTINENTAL DIVIDE
Stanford
Lewistown
LITTLE BELT MOUNTAINS
BIG BELT MOUNTAINS
White Sulphur Springs
CASTLE MOUNTAINS
Harlowton
Roundup
Forsyth
Hysham
Broadview
Colstrip
BILLINGS
Laurel
Columbus
Hardin
Big Timber
Livingston
Bozeman
Trident
BUTTE
Anaconda
Deer Lodge
Garrison
Boulder
Radersburg
Townsend
Hamilton
BITTERROOT MOUNTAINS
SAPPHIRE MOUNTAINS
FLINT CREEK RANGE
PIONEER MOUNTAINS
BRIDGER RANGE
CRAZY MOUNTAINS
CROW INDIAN RESERVATION
NORTHERN CHEYENNE INDIAN RESERVATION
Plains

Figure I-3

SUMMARY

A procedure has been developed to assist in estimating potential environmental impacts of introducing power line corridors into a study area. The methodology involves the derivation of impact scores for each corridor section, based on the distance and sensitivity of various resources occurring within the corridor and the relative importance of each resource. Each major resource is considered to be a determinant which is composed of more specific resources called data items. Each data item must be displayed as a resource map which can be superimposed with a corridor location map. Numerical analogs are applied to the data items according to the level of seriousness of potential impacts on each resource. The distance of each corridor segment which crosses each level of resource sensitivity is measured and multiplied by the corresponding analog to derive a data item impact score. Analogs are also applied to each determinant to represent relative importance of impacts on various resources. The data item impact score is multiplied by the determinant value to derive a determinant impact score. These scores are adjusted if the corridor segment has existing power lines to account for reduced potential impacts where power line intrusion has already occurred. The resultant adjusted impact score provides an estimate of the total potential environmental impact on each segment upon introduction of a power corridor. These impact scores can serve as a means to help make environmental decisions concerning the best (least-impact) locations for a corridor.

This procedure can be employed at any scale of analysis. That is, it could be used to assess potential impacts within a corridor several miles in width, or for specific center-line location studies. Data and resource information which are already available for most areas can provide the basis for the analysis. The more detailed and precise the information, the more reliable are the results of the analysis as a decision tool. The methodology also allows the user to see how each resource influences the overall impact score.

With adjustments to account for differences in study areas, the procedure can be used to assess potential impacts of power line projects of those areas. Furthermore, it can be utilized for other corridor-related utility studies, such as pipelines, highways, and railroads.

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APPENDIX [1/]

DETERMINANTS

Determinants are major categories of resources considered to be subject to potential impact resulting from the construction, operation, and maintenance of two 500-kV electric transmission lines. The list of determinants if limited to those resource categories which the Study Team felt could receive impacts of reasonable magnitude. Determinants can be composed of one or more data item; any data item can be used in more than one determinant (see Figure IV-4).

Although all of the resource categories listed as determinants are considered to be important and to have a reasonable potential to be impacted, they are not equally important or sensitive to being impacted. Thus, the determinants were weighted relative to each other by using the values of 1, 2, and 3. A determinant with a weight of 3 had more ultimate influence on total impact scores than a determinant with a weight of 2, and a weight of 2 was more influential than a weight of 1.

The Team used the responses of the State's public opinion surveys and its own professional judgment to assign determinant weights. Special attention was given to resource categories which the public considered to be important, although such public opinion of resource importance was tempered by the team's evaluation of impact potential. The impact analysis was based on the assumption that construction techniques commonly used today would be used for the installation of the proposed power lines, including road access to the right-of-way so that ground equipment could be used in clearing, constructing towers, and stringing the conductors.

A list of the determinants used for Step 1 analysis purposes and their relative importance weights follows:

1/ - The materials in this appendix were extracted from USDI, 1978, Federal Interagency Colstrip Transmission Corridor Analysis. All figures, tables and reference citations in this appendix are found in that document.

Natural	Weights 1/
Fish and Wildlife	2
Land Suitability	2
Surface Water	1
Vegetative Cover	2
Unique Natural Resource	3
Economic	
Agricultural Land	2
Commercial Forest Land	3
Rangeland	1
Social	
Recreational Resources	2
Land Management Plans	-
Prehistoric and Historic	2
Human Population	2
Visual	
Scenic Quality	3
Visual Sensitivity	3
Legal	
Legal Constraints	-

1/ - These weights reflect the Colstrip Transmission Study Team's interdisciplinary assessment of the relative importance of resources for all 15 corridor segment determinants with respect to the establishment of a corridor for two 500-kV transmission lines. The higher the number, the more important the impact.

DATA ITEMS

Each data item represents an individual resource or some facet of a resource within the study area which is likely to be influenced by electric power transmission facilities. Data items included in Step 1 analysis were limited to those resources for which data (maps) were available or could be developed in a short period of time. The Study Team also restricted the list of data items to those resources which it considered to be significant within the study area, excluding those resources which would have only a very remote chance of being impacted. Data items used for Step 1 analysis include:

LAND SUITABILITY
- Good
- Fair
- Poor

SURFACE WATER
- Sediment Risk - High
- Sediment Risk - Medium
- Sediment Risk - Low

FISH AND WILDLIFE
- High Impact Potential
- Medium Impact Potential
- Low Impact Potential
- Threatened and Endangered Animal Species

VEGETATION
- Agricultural Land
  - Prime and Unique Farm Lands
  - Irrigated Land
  - Dry Land Farming
- Rangeland
- Good Productivity/Poor Recoverability

Fair Productivity/Fair Recoverability

Poor Productivity/Good Recoverability

Forest Land

Cool & Moist - Cold & Moderately Dry

Warm & Very Dry

Warm & Dry

Moderately Warm & Dry - Moderately Cool & Moist

Varied Climate

Threatened and Endangered Plant Species

Wetlands

SPECIALLY MANAGED AREAS

Wilderness/Primitive

New Wilderness Study Areas

Roadless Areas (Includes Essentially Roadless)

Natural Areas (Pristine, Relict, Geologic, Scenic, and Landmarks)

Game Refuges and Ranges

State Parks and Recreation Areas

Wild and Scenic Rivers

Scenic Travelways

Recreation Waterways

Management Objectives for Specified Areas

RECREATION SUITABILITY

High Impact Potential

Medium Impact Potential

Low Impact Potential

PREHISTORIC AND HISTORIC

National Register Sites and Trails

High Sensitivity Zone

Medium Sensitivity Zone

Low Sensitivity Zone

VISUAL

Scenic Quality

High

Medium

Low Visual Sensitivity

Level 1

Level 2

Level 3

POPULATION DENSITY AND PROXIMITY

49> Persons Per Square Mile

5-49 Persons Per Square Mile

<5 Persons Per Square Mile

Population Center Crossed by or within 1 Mile of Corridor

DESCRIPTION OF DETERMINANTS AND DATA ITEMS

The following discussion deals with the data item composition and the importance weighting for each determinant. For each determinant, data items are defined, sources of information are indicated, and the development and mapping of levels of sensitivity to impact, are described.

Fish and Wildlife

Definitions

Game Refuges and Ranges - These lands are controlled by the Montana Fish and Game Commission and managed for the protection of certain areas of critical game habitat. Species generally featured are elk, mule, deer, grouse, pheasant, and waterfowl. Much of the land is owned by the Montana Fish and Game Department, but leased lands from Federal agencies and private landowners are included. The National Bison Range, administered by the U.S. Fish and Wildlife Service, is also included in this category.

Wildlife Impact Potentials - are assessments of the importance of wildlife habitat (weighted by species value and the value of an habitat to a species) and the probability that significant impacts would occur.

Assumptions

Several important assumptions were made in assessing wildlife impact potentials. More detailed support for these assumptions is found in the analysis of impacts (Chapter VII).

1. The presence of a power line right-of-way on a grassland or sagebrush ecosystem would only slightly alter the pattern and distribution of potential and existing vegetation.

2. Powerline rights-of-way have a much greater impact on forested ecosystems than on grassland or sagebrush systems.

3. Certain wildlife species have specific habitat requirements of such limited distribution as to deserve special consideration.

4. Emphasis on large mammals appropriately reflects both public interest in them and their biological significance. The large mammal species are more vulnerable to habitat modification than most small animal species.

5. Access roads and construction activities have long term impacts to the degree that such roads or activities reduce productivity through soil disturbance or provide unwanted public access.

6. Within a 2-mile wide corridor, sufficient latitude is available to avoid such specific features of habitat as elk wallows or grouse drumming grounds.

7. No adverse impacts on animals other than birds have been demonstrated for extra high-voltage structures. Birds are known to collide with the structures, but the exact significance of collision mortalities on bird populations is unknown.

8. Cool moist forest associations are important components of habitat for many wildlife species of interest, including wolverine, fisher, marten, and black-backed and northern three-toed woodpeckers.

Development and Maps

Wildlife and fisheries impact ratings were developed as a summation of game habitats, fishing streams, and cool moist forested habitats affected by corridor segments. The game habitats were weighted by resource and aesthetic value of a species, and by the importance of a habitat to a species. Multiplicative values of 1, 2, or 3 for resource value, aesthetic value and habitat importance produced game species habitat importance values (Table IV-1). The two nonspecific wildlife habitats (fishing streams and cool moist forested habitats) were similarly rated. The habitat importance values for each species and the two nonspecific habitats were graphically summed on a mile-by-mile basis for every corridor segment. An additional multiplier of three was used for all forested habitats (including deciduous stream bottoms) to produce a total wildlife impact rating.

The total impact ratings were grouped into high, moderate, and low impact potential categories to provide data comparable to those for other resource determinants. Total impact ratings greater than 80 were considered to be high; between 30 and 80 (inclusive), moderate; and below 30, low. (Forested key elk habitat has a rating of 81, non-forested key elk habitat has a rating of 27, and forested deer general winter range has a rating of 36.) These cutoff points appear to provide a reasonable distribution of high, moderate, and low potential impact values for single and multiple species habitat occurrence.

Game distributions (general, winter range, and key) were used as mapped by the Montana Fish and Game (on file in Bozeman, Montana) with the cross-referencing of the Montana DNRC/DEIS (1974). Areas of discrepancy were resolved through professional judgment, personal knowledge of the area, and consultation with Montana Fish and Game Regional Managers.

Montana fishing streams have been rated as Class I, II, III, or IV by the Montana Fish and Game Department. Cool moist forest habitats include ecoclasses 6, 7, and 8 (On and Losensky 1975), and were mapped by the Forest Service. General potential vegetation maps (e.g., Morris 1964) revealed only one corridor segment not mapped for habitat types by the Forest Service which might need classification as cool moist forest. Concurrence of two general vegetation maps (Morris 1974; Taylor, et al. 1975) in classifying the area as alpine or near alpine resulted in including portions of that segment in the cool moist forest habitat. Grizzly bear "critical habitat" was mapped as described in the U.S. Fish and Wildlife Service proposal (USDI 1976a). Wetlands were identified from sectional scale aeronautical charts, and 1:250,000 USGS quadrangel maps. State game ranges were identified from Montana DNRC/DEIS (1974) maps.

Composition and Value of Data Items

The Wildlife determinant is comprised of wetlands, wildlife impact potentials, proposed critical grizzly bear habitat, and game refuges and ranges. Wildlife impact potentials were rated high (4), moderate (2) and low (1). Wetlands, proposed critical grizzly bear habitat, and game refuges and ranges were all rated high (4). Wetlands are uniquely productive of wildlife, including waterfowl, shorebirds, and furbearers. Proposed critical grizzly bear habitat was given a high rating, a very conservative assessment of impact potential. Game refuges and ranges are rated high for their importance as wildlife habitat, and for the commitment and investments on the part of State and Federal agencies.

Determinant Value

The Wildlife determinant was given an overall weighting of two (on a 1-3 scale) relative to other determinants. This reflects a moderate to high public interest in wildlife and low to moderate probability of adverse impact.

Land Suitability

Definitions

Land Suitability - the ability of the land to sustain a use (in this case, electric transmission facilities) considering the natural constraints and restrictive factors of physiography (form and arrangement of the earth's crust), geology (bedrock formation), climate (precipitation zones), soil (depth, structure, fertility, porosity, erosion potential), and vegetation (productive potential).

Good Land Suitability Rating - limitations can be overcome by normally applied practices. No special treatment required.

Fair Land Suitability Rating - limitations can be overcome by special design, location, or practices which are available, but not normally used. Suitable for the use, but at additional cost.

Poor Land Suitability Rating - limitations are difficult and/or costly to overcome. Either technology is not available, or it is extremely costly to apply. The land may be allocated to the use, but an environmental cost is unavoidable.

Development and Maps

Land suitability ratings and definitions were taken from *Land Suitability Pattern for Electric Transmission Lines* (USDA Forest Service 1976a). This publication includes a 1:500,000 map of land suitability. Suitability is mapped by land mapping units called subsections, which are defined using physiographic, geologic, and climatic criteria, along with inferences from soils and vegetation.

Mapped subsections were assigned "good," "fair," or "poor" ratings according to their ability to sustain electric transmission facilities. The following geomorphic properties were considered in assigning these ratings:

1. flooding hazard and presence of high water table;

2. trafficability (potential for frost heaving or dust hazard);

3. bearing capacity when wet;

4. mass failure hazard (landslides or slumping);

5. slope steepness (steep slopes make construction more difficult and expensive);

6. presence of rock outcrops (rock outcrops also make construction more difficult and expensive);

7. erosion and sediment risk; and

8. presence of hard massive rock at shallow depths (contributes to construction difficulty and expense).

A "poor" rating was assigned to all subsections which exhibited the following limitations or combination of limitations:

1. severe mass failure hazard;

2. steep slopes with severe erosion and sediment hazards; and

3. steep slopes with shallow hard rock which would make construction extremely difficult.

"Fair" or "good" ratings were assinged to all other subsections. These ratings were assigned on the basis of the difficulty in overcoming the limitations.

The Land Suitability map (see Figure III-6) does not cover the portion of the study area between Colstrip and Broadview. However, by using maps of topography, precipitation, and soils, suitability ratings were assigned to these segments, based on the above approach.

Composition and Value of Data Items

The only data item used in the Land Suitability determinant was "Land Suitability". The overall suitability ratings accompanying the suitability map were based on the most pertinent properties of soil and topography (erosion hazard, depth to water table, slope steepness, mass failure hazard, etc.), and it was therefore determined that the suitability map would adequately satisfy the need for soils and topographic information.

The map and the interpretations assigned to each mapping unit provided a rating of good, fair, or poor for electric transmission line suitability. In developing the Land Suitability determinant, the mapping units which had been assigned a poor rating were given a high value (number analog of 4) and were therefore considered to be the least desirable for use. The rationale was that areas given a poor rating would suffer the most severe impacts, and these impacts would be the most difficult and costly (if not impossible) to overcome. Mapping units which had been assigned a fair rating were given a medium value (number analog of 2). Mapping units which had been assigned a good rating were given a low value (number analog of 1) and were therefore considered preferable. The impacts on these areas would be the least severe and the easiest and least costly to overcome.

Determinant Value

The Land Suitability determinant was assiged a value of 2 on a scale of 1 to 3. This reflects the fact that soils within the right-of-way would be disturbed during construction, but the disturbance would not be permanent or of extreme magnitude. Thus, its importance is considered to be only moderate.

Surface Water

Definitions

Sediment Risk - an evaluation of the probability of soil eroded from areas disturbed by construction activities entering surface drainage channels.

High Sediment Risk - the hazard is difficult and costly to overcome.

Medium Sediment Risk - the hazard may be overcome by special measures which are commonly available and economically practical to apply, but which increase the cost of building the transmission lines.

Low Sediment Risk - the hazard may be overcome by normally used practices. No special treatment is required.

Development and Maps

The determination of sediment risk was taken directly from Land Suitability Pattern for Electric Transmission Lines (USDA Forest Service 1976a), including the 1:500,000 Land Suitability map. Each mapped subsection was evaluated individually for the probability of sediment being produced in its surface drainage channels. The primary considerations were soil erosion hazard, stream channel density, and slope. On the suitability map, each subsection is rated severe, moderate, or low for sediment risk. These terms have been changed to high, medium, and low, respectively, in this report.

Composition and Value of Data Items

The "Sediment Risk" and "Wetlands" data items were used to develop the Surface Water determinant. Sediment risk was used because an increase in sediment during construction would be by far the most significant impact on surface water systems. Wetlands were included in order to give proper consideration to their unique natural and beneficial values as directed by Executive Order 11990 (May 24, 1977).

All wetlands and all areas with a high sediment risk were given a high value (number analog of 4). These areas were therefore considered to be the least desirable for use. The rationale was that wetlands and high sediment risk areas would suffer the most severe impacts, and in many cases these impacts would be nearly impossible to overcome with mitigating measures. Areas with a medium sediment risk were given a medium value (number analog of 2). Areas with a low sediment risk were given a low value (number analog of 1), and they therefore were given priority for use in regard to the surface water determinant. The areas with a low sediment risk would suffer the least severe impacts, and the impacts would be easiest and least costly to overcome.

Table IV-6 lists the number of streams crossed by each corridor segment. This information was not used as a separate data item because it is a measure of stream channel density, which was an integral part of the sediment risk data itme. Since stream channel density had already been considered, its inclusion as a separate data item could not be justified.

Determinant Value

The Surface Water determinant was assigned an importance value of 1 on a scale of 1 to 3. This reflects the fact that the primary impact on surface water (increase in sediment) would be short term (during the construction period), and also that, in most cases, the transmission lines could span streams without disturbing the stream ecosystem.

Vegetative Cover

Definitions

Agricultural Lands - as a data item under the Vegetative Cover determinant, are grouped together regardless of crop type or management practice. Both irrigated and nonirrigated (dryland) lands are included in this category. Rangelands are not included because they are considered as a separate resource.

The agricultural lands category includes all lands currently being used for commercial production of annual crops and hay. Such lands are tilled annually or in a rotation scheme (see Figure III-14).

Rangelands - as a data item under the Vegetative Cover determinant, are grouped together regardless of their type or management (see Figure III-8). All lands on which the native vegetation (climax or natural potential) is predominatly grasses, grass-like plants, forbs or shrubs suitable for grazing or browsing use are included. This resource is discussed in more detail under "Rangeland," in this chapter.

Forest Lands - as a data item under the Vegetative Cover determinant, are grouped together regardless of their type or management. This category includes all land which: (a) has at least 10 percent of its surface stocked by trees of any size; (b) is capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; or (c) has had the trees as described above removed to less than 10 percent stocking, and which has not been developed for another use. This resource is discussed in greater detail under "Commercial Forest Land," in this chapter.

Development and Maps

A composite Vegetative Cover map is an overlay of the agricultural land, rangeland, and forest land information (see Figure IV-5). Development of this information is detailed under these respective resource categories later in this chapter.

Composition and Value of Data Items

The Vegetative Cover determinant is composed of five data items: wetlands, agricultural lands, rangelands, forest lands, and threatened and endangered plant species. Wetlands were included in this determinant for two reasons. First, true wetlands have a vegetative composition unlike the other three data items and, therefore, should be considered as a separate entity. Wetlands were also included in order to give proper consideration to their unique natural and beneficial values as directed by Executive

Order 11990 (May 24, 1977). All wetlands were assigned a high sensitivity value (4) in developing the Vegetative Cover determinant.

Threatened and endangered species were also rated high (4) in the Vegetative Cover determinant, but as no threatened or endangered plants have been as yet officially recognized, and as no plants tentatively listed by the Smithsonian Institution (1975) or the USDI (1977) are known to exist along the proposed or alternative corridors, this data item was not utilized in the determinant evaluation.

The remaining three data items were ranked relatively, according to the ecosystem stabilizing influence of each. Forest land, regardless of forest type, was considered to be highly sensitive to transmission line impact and was assigned a value of 4. This rating was considered necessary in light of the stability that forest cover provides. To a high degree, forests are limited to mountainous and hilly terrain, where the preponderance of steep slopes, thin soils, and high precipitation zones occur. Since trees are the major factor maintaining the ecosystems of these areas, removing this vegetation to provide a power line right-of-way could have significant consequences.

Rangelands were given a medium rating (2), as they provide less ecosystem stability than forests, but more than agriculture lands (rated 1), which undergo major disruptions and cover type changes, often on an annual basis. Rangeland stability is influenced primarily by precipitation patterns and livestock management practices. In areas of high rainfall and under proper livestock grazing plans, soil erosion is minimal. Because of the continual vegetative cover and topsoil disturbance, even under the best agricultural practices, there are greater amounts of topsoil losses than from the other vegetative types.

<u>Determinant Value</u>

The Vegetative Cover determinant was assigned a value of 2 (moderate importance of potential impact). In relation to impacts on other resources

within the study area, the potential disturbance of the vegetation from introducing a power corridor would not be the most important impact, but of sufficient importance to be ranked intermediately.

Unique Natural Resources

Definitions

Wilderness/Primitive Areas - Wilderness areas are formally classified by an Act of Congress under the provisions of the Wilderness Act of 1964 (PL 8857). Primitive areas were administratively designated by either the Secretary of the Interior or the Secretary of Agriculture prior to the passage of the Wilderness Act.

Wilderness, in contrast to those areas where man and his works dominate the landscape, is defined as areas where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. Wilderness is further defined in this Act to mean an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

New Wilderness Study Areas - Areas that have been designated by Congress for wilderness study, wilderness proposals endorsed by the Administration and pending before Congress or areas designated by the agency for wilderness study. A new study area is removed from standard management and planning considerations until its status as a wilderness area is determined.

Roadless Areas - Areas of undeveloped Federal land within which there are no improved roads maintained for travel by means of motorized vehicles

intended for highway use. Narrow projecting tentacles or fingers of roadless land are generally excluded from the classification.

The second Roadless Area Review and Evaluation (RARE II) is a nationwide review of all uncommitted roadless and undeveloped Federal lands to determine their suitability for inclusion in the National Wilderness Preservation System or for other possible uses. The inventoried RARE II lands will be placed into three separate categories:

1. those to be recommended for immediate addition to the National Wilderness Preservation System;

2. those which will undergo further study to determine whether or not they should be included in the Wilderness System; and

3. those which would be managed for resource values other than wilderness.

These recommendations will be sent to the Secretary of Agriculture for further review and administrative or legislative action.

Natural Areas - A physical and biological unit in as near a natural condition as possible which exemplifies typical or unique vegetation and associated biotic, soil, geologic, and aquatic features. The unit is maintained in a natural condition by allowing physical and biological processes to operate, usually without direct human intervention.

State Parks and Recreation Areas - Areas that are officially designated and recognized in the Montana Statewide Outdoor Recreation Plan (4th Edition), prepared by the Montana State Fish and Game Commission, March 1, 1973.

Wild and Scenic Rivers - The Wild and Scenic River Act, as amended through P.L. 94-486, declares that it is the policy of the United States that certain selected rivers of the nation, which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values,

shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Act provides for three classifications:

1. Wild River Areas - Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America;

2. Scenic River Areas - Rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads; and

3. Recreational River Areas - Rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Wetlands - Areas of extensive aquatic, emergent, and riparian vegetation periodically or permanently flooded with shallow water.

Threatened and Endangered Species (plants) - None have been officially recognized or known to exist along the corridors within the study area.

Development and Maps

A transmission line crossing any of these data item areas would create an impact not only on the resources of the area, but also on its management. Management plans would have to accommodate this type of use or undergo significant changes in philosophy and objectives. In the case of Wilderness Areas, political action would be needed to declassify the transmission line corridor. The impact potential on management would have to be explored in detail to resolve of any conflict; for the purposes of this report, only the highlights are presented (Chapter III).

The many sources used to map these items were provided by Federal or State agencies. Data were gathered from the U.S. Forest Service, Soil Conservation Service, Bureau of Land Management, Bureau of Outdoor Recreation, Montana Department of State Lands, Montana Department of Fish and Game, and the Montana Department of Natural Resources and Conservation.

Composition and Value of Data Items

This determinant is composed of certain data items that are in their natural state, or have been only minimally impacted by man's activities. The exception to this is plant communities that have been influenced by fire suppression. The data items are: Wetlands, Threatened and Endangered Plant Species, Wilderness/Primitive Areas, New Wilderness Study Areas, Roadless Areas, Natural Areas, State and County Parks, and Wild and Scenic Rivers.

The unique plant communities located in wetlands, threatened and endangered plant sites, and natural areas have a high (4) potential for impact from transmission line construction because of their small size and very limited distribution. Maintenance of these areas is of national or state significance in preserving natural ecosystems.

Wilderness/Primitive Areas, New Wilderness Study Areas, and Wild and Scenic Rivers also have a high (4) impact potential. The introduction of a transmission line through one of these areas would depreciate the size and/or the intrinsic values that helped to establish recognition of the area.

State and County Parks are given a medium (2) impact potential rating. The parks are generally located around and managed for significant natural features such as waterfalls, caverns, or old-growth trees. The areas have a lower impact potential than those noted above because some modification of the environment has already been made to accommodate visitors. Camping, picnicking, access, parking, and various shelter facilities are generally in close proximity to the natural feature(s) and so the naturalness of the area has already been compromised to some degree.

Roadless Areas are on a lower level of protection than classified areas and parks, and of a lower value for protection than areas containing threatened and endangered plants or pristine and unique vegetative communities. For these reasons roadless areas are given the lowest (1) impact potential rating. Roadless areas also contain many man-made intrusions such as primitive roads, mining, and prospecting pits, and old structures.

Determinant Value

The value for this determinant is high (3). This rating reflects both the overall public regard for these items and the high impact potential that transmission line construction and maintenance would disturb or eliminate areas containing significant natural vegetative communities. It is believed that once some of these natural communities are disrupted, they cannot be reproduced.

Agricultural Land

Much of the surface vegetation of Montana is represented by agricultural crops. As such, the vegetation varies from one year to another, and even from month-to-month. On nonirrigated agricultural lands, fields are often left idle during alternate years (or in some rotation pattern) as summer fallow. During this time, there will be no growing vegetation on that field so, in certain cases, the land may be essentially bare for 20-21 months out of a 2-year rotation period. Under irrigation, crops are usually grown each year, or a perennial forage crops is produced. The main crops grown under nonirrigated conditions in Montana are winter wheat, spring wheat, barley, and oats. Irrigated lands are used mostly to produce potatoes, sugar beets, corn, dry beans and forages. A few specialty crops grown under both irrigated and nonirrigated conditions include mustard, safflower and grass, and forage seed crops.

Definitions

Prime and Unique Agricultural Lands - are agricultural lands which are uniquely suited to specific agricultural production pursuits, or which

are classed as "prime" lands by State or Federal agencies. An example of unique farmland is that land surrounding parts of Flathead Lake which is uniquely suited for cherry orchards as a result of the ameliorating effect of the lake on local climate and the deep, coarse-textured soils. According to Federal standards, prime and unique farmlands are described in Soil Conservation Service (SCS) "Land Inventory and Monitoring" memo 3, revision 1, August 16, 1977. These lands have not been mapped in Montana.

Irrigated Lands - are those which receive supplemental water applications on a more or less regular basis, and which also are identified as agricultural lands as previously defined in the "Vegetative Cover" section of this chapter.

No breakdown is made based on type of water application system. These range from surface flood irrigation to wheel-roll, big-gun, and center-pivot systems.

Nonirrigated Lands - must rely on precipitation to supply water for crop growth. These nonirrigated lands include large acreages of summer fallow, a system under which crops are grown on an alternate year schedule, by which the soil is tilled for weed control and water storage during the fallow period.

Development and Maps

Recent land-use maps which show the location of cultivated agricultural lands are avilable for only a few counties of Montana. Within the study area, such maps are available for Rosebud and Treasure Counties through a recent "Section 208" water quality management plan and study conducted by the Yellowstone-Tongue Areawide Planning Organization. Similar maps for Big Horn, Yellowstone, Stillwater, and Sweetgrass Counties were developed at a scale of 1:250,000 by the Mid-Yellowstone Areawide Planning Organization. However, lack of mapping control makes them of little value for identifying exact locations of agricultural lands in relation to specific corridor segments.

Land-use maps for Lake County which were published in the January 1977, "Report of the '208' Study for Flathead Drainage," are too small and generalized to be of value except to indicate large agricultural areas within the county.

A detailed agricultural land-use map for the area of southeastern Montana underlaid by strippable coal is available from the Department of Natural Resources and Conservation in Helena. Agricultural lands (as of 1974) crossed corridor segments in Rosebud, Treasure, and Big Horn Counties are identifiable on this map.

To develop a map of all agricultural lands of the study area, satellite imagery prints were used. These prints (false-color imagery composites of bands 4, 5, and 7, ERTS Satellite, 1:500,000 scale) show quite clearly land surfaces that have been disturbed by tilling. Also, various crops show distinct color "signatures" which are distinct from range or forest land. Images taken during 1976 summer months were obtained through cooperation of the USDA-LACIE coordinator in Houston, Texas. The LACIE (Large Area Crop Inventory Experiment) program is designed to identify agricultural crops from satellite imagery. The prints obtained were selected for their clarity and detail in showing cropped areas. Also, the recent information from these images was used to update some of the older information sources.

A composite map of the entire study area was made from nine different false-color ERTS prints. The linear geometric configurations and color differences of agricultural areas could be quite readily identified and traced onto a mylar overlay. Water bodies (lakes and streams) were used as mapping control points. To supplement this data source, a composite map of irrigated lands of the study area was made from "An Atlas of Water Resources in Montana by Hydrologic Basin," Inventory Series Report No. 11 of the Montana Water Resources Board in Helena. This atlas shows all irrigated agricultural lands, many of which are too small and isolated to be readily discernible on satellite imagery. Accuracy of the map derived from combination of these two data sources was verified by comparison with the recent land-use maps developed by "208" projects mentioned earlier. Also, this map was checked by flying all corridors,

revealing that only a few small, irregularly shaped fields in rough, broken lands had not been identified (see Figure III-14).

A corridor segment overlay map, superimposed on this map of agricultural land, allowed for measurement of the distance each segment crosses these lands.

Composition and Value of Data Items

The Agricultural Land determinant is composed of three data items: prime and unique lands; irrigated croplands; and nonirrigated croplands.

A number of areas of agricultural land may be considered "prime" land due to inflated real estate values, but this value is usually caused by factors other than agricultural production capacity. Factors which increase values of such lands are considered in other categories, and thus enter into the evaluation of corridor segments in that way. Prime or unique agricultural lands would be afforded a high impact rating (4) if they were found to be crossed by a segment. However, none were identified within the study area.

Within the Agricultural Land determinant, irrigated lands would have a potentially high impact from a powerline. The two major reasons for this are: (1) irrigated lands usually produce greatest yields and highest values of crop production, and areas removed from further production would result in relatively large economic losses per unit area and (2) irrigation systems (with the exception of flood irrigation) involve the use of equipment which often requires large spaces for unimpeded movement (e.g., wheel-roll and center-pivot systems). Powerline structures may interfere with locating and operating such systems. For these reasons, irrigated land was given a high (4) impact rating.

The main impact of a powerline crossing nonirrigated agricultural lands is the difficulty of maneuvering large tillage, seeding and harvesting equipment around the power structures or guy wires. There also is some impact on total production since some area is removed from crop production. Nonirrigated land was considered to have a moderate (2) impact rating.

Determinant Value

The Agricultural Land determinant consists of a combination of irrigated lands and nonirrigated land (since no prime and unique lands have been identified). If this determinant were considered as a unit in the economic environment, the impact of a power corridor would be moderate (2). The amount of acreage taken out of production would be quite small (except during the construction phase), and increased farm management costs would not be great. Comparatively, this degree of impact would be intermediate or "moderate" in importance.

Commercial Forest Land

Definitions

Forest Land - Land which: (a) has at least 10 percent of its surface stocked by trees of any size; and (b) is capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; or (c) has had the trees as described above removed to less than 10 percent stocking, and which has not been developed for another use.

Forest Type - A category of forest land defined by its vegetation, particularly by its composition. The type is usually named for the species that dominates by numbers (seedlings and saplings) or by volume (poles and sawtimber). In Step 1, the types are named by the general temperature and moisture characteristics that predominate for the various forested lands.

Site Index - A particular measure of forest productivity based on the average height of the dominant and codominant trees in a stand at an arbitrarily chosen age. In this report, the site index is give for a 50-year base period.

Commercial Forest Land - Forest land which is (a) producing, or physically capable of producing, usable crops of wood (usually sawtimber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization.

Tree Size - Tree size is generally categorized into the following three groups, based on diameter breast high (dbh):

a. Sawtimber - Trees having dbh of 9 or more inches.
b. Poles - Trees with dbh of 5-9 inches.
c. Seedlings and Saplings - Trees with dbh of less than 5 inches.

Stocking - A measure of the proportion of land area actually occupied by trees, expressed in percent of canopy closure:

Well stocked	-	70-100 percent
Medium stocked	-	40-69 percent
Poorly stocked	-	10-39 percent

Merchantable - Trees, crops, or stands of a size, quality, and condition suitable for marketing under given economic conditions, even if so situated as not to be immediately accessible for harvest.

Development and Maps

The data items comprising forest land have been redefined from Step 1 in order to better correlate the data item components and their productivity. Interpretations made for rangeland occurring on forested lands are also consistent with these new data items as the same typing classifications were made for both resources.

Data items are described under "Principal Vegetation Types" (Chapter III). Productivity is measured as growth in cubic feet per acre per year, based on National Forest averages. These averages are good only for comparing corridors or segments of corridors because they represent combinations of species, age classes, and stocking levels within each forest type. The growth rate potentials are also based on the assumption that some form of timber management, such as stocking control, is being applied to the stands.

The map is taken from the publication "Vegetative Rangeland Types in Montana" (MSU 1973). In addition to this publication, interpretive data are from compilation work by Chaffee (1973) and data collected by the USDA Forest Service.

Habitat typing, or classifying forest land according to its potential climax vegetative community, is not available for most of the forested land so it could not be used for assessing the potential productivity of the forested lands.

Composition and Data Item Values

As in Step 1, this determinant considers only those areas of forest land and defined as commercial forest land, including the Western Larch/Douglas fir, Lodgepole Pine/Douglas fir, Western and Eastern Montana Ponderosa Pine, and the Ponderosa Pine Savannah types.

The greatest impact on timber stands from the introduction of a transmission line would occur in the most highly productive forest types, such as the Western Larch/Douglas fir and Eastern Montana Ponderosa Pine types are rated moderately productive and have a medium impact potential. The Ponderosa Pine Savannah, with its wider spacing of trees and low volumes per acre, would receive a low impact from clearing for a transmission line.

Determinant Value

The value for this determinant is 3 (high). This rating is based on the overall high impact potential associated with the clearing of forest lands in the right-of-way and for roads that have to deviate from the right-of-way in mountainous terrain. The duration of the impact (keeping trees cleared from around towers, in areas of low conductor sag, and on permanent roads) would be as long as the powerlines exist. Timber harvest operations in areas adjacent to the right-of-way may also be influenced because of constraints placed on equipment use in the vicinity of the lines.

Rangeland

Definitions

Rangelands - are lands on which the native vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing. They include lands revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. Rangelands include natural grasslands, savannahs, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows (SRM 1974). As much of the forest within the study area is also grazed by livestock, forest land was also included in this analysis.

includes more than forage

Productivity - refers to the amount of biomass produced in a given area during a given amount of time. Productivity can either be expressed as the number of pounds of forage produced per acre, or as the number of acres required to support one animal unit for 1 month (Acres/Animal Unit Month). An animal unit is considered to be one mature (1,000 lb.) cow and her calf under 6 months old, or the equivalent, based upon average daily forage consumption of 26 pounds dry matter per day (SRM 1974). Acres per Animal Unit Month (a/AUM) was the unit of measurement used in this analysis.

NO

Recoverability - In general, relative recovery relationships will remain the same whether defined in terms of aesthetics, erosion stabilization, or productivity. That is, the amount of time it takes to achieve the "recovered" level in one vegetative type relative to another vegetative type will remain essentially the same. However, in order to assign ratings, three criteria, as defined by DNRC/DEIS 1974, were used to provide a more concrete definition:

a. Life-forms - An area is not considered recovered unless indigenous late-successional life-forms dominate.

b. Erosion Prevention - Soil development partially determines which plants can grow and prosper in an area. Soil evolution is a very slow process, often measured in hundreds and thousands of years.

In order for an area to recover, its soil must be kept relatively intact. For this reason, prompt revegetation during the same growing season with plants that prevent accelerated erosion and invasion by undesirable plants is a necessary part of recovery.

c. Productivity and Economic Properties - Recovery includes establishing plant communities with productive and economic properties similar to those of predisturbance communities. Areas where recovery proceeds slowly due to limiting factors are more severely impacted by construction activities than are sites that recover more quickly.

Development and Maps

The map titled Potential Vegetative Rangeland Types was used for the rangeland analysis in Step 1 (Figure III-8). This map was originally developed in the early 1940's by Inter-Agency Range Committee composed of Federal and State agencies. This committee produced a vegetational type map of Montana with type descriptions. The map was updated in 1973 by the Department of Animal and Range Sciences, Montana Agricultural Experiment Station, Bozeman, Montana.

The base data used in the preparation of this map were derived, primarily, from range surveys and range reconnaissance studies, and soil surveys and soil reconnaissance studies of the member agencies. These data were supplemented by committee members and range technicians with personal knowledge of Montana range conditions (MSU 1973).

This map shows classification of vegetation by broad vegetative types. The type boundary delineations were based on potential or climax communities that would be found in the area if it had not been for the past major disturbances by man.

The fact that vegetative types based on climax associations were used in this analysis does not imply that all or even most of the study area is in a state of climax or that climax communities are necessarily the most desirable from a range management standpoint. Rather, vegetative typing based on the potential for any given area allows the recognition of

inherently similar areas despite the camouflaging effects of disturbance.

Further, potential productivity rather than existing productivity was used as one of the parameters in the Step 1 analysis because power transmission lines require long-term commitment of land; therefore, using existing productivity could result in shortsighted impact allocation. Also, existing productivity cannot be accurately predicted by vegetative typing because of variable history and stand development. However, it is expected that comparative productivity rankings, whether potential or existing, would be the same, although the values for potential and existing productivity would differ.

Productivity - The delineation of rangeland vegetative types within the study area, and potential productivity for each type, expressed as a/AUM, were taken from Bulletin 671, Vegetative Rangeland Types in Montana, Montana Agricultural Experiment Station, Montana State University, Bozeman (1973). The a/AUM values for each vegetative type are listed in Table IV-2.

In calculating the range productivity potential, it was assumed that forests will remain as forests, and will not be managed as rangelands. To do otherwise would invalidate the forest productivity ratings, since a site cannot normally be managed to simultaneously maximize both timber and grass production. Using the criteria established by the Montana's Department of Natural Resources and Conservation (DNRC) for the Clyde Park-Dillon Transmission Line EIS, the most productive forest vegetative types are equivalent to the least productive grassland types with respect to range productivity. Forest types were rated as 1, 2, or 3, while grassland types were rated as 3, 4, or 5 (Table IV-2). A high rating refers to a highly productive vegetative type, therefore a high impact potential exists.

Recoverability - The recoverability criteria also follow those established by the DNRC for the Clyde Park-Dillon Transmission Line EIS. The consultant's report for the Colstrip to Hot Springs, Montana Transmission Line, Westinghouse Project ESD-090-73, by George B. Chaffee (1973), was also utilized to assign the recoverability values.

Forest vegetative types as a group were rated slower in recovery than grassland vegetative types and assigned either a 5, 4, or 3, for, in a sense, forest types never recover as long as a transmission line exists. This rating is justified in terms of the definition of recovery stated previously:

a. Life-form - the dominant late successional life form (trees) is not allowed to dominate.

b. Erosions Prevention - forests are generally most effective in reducing erosion but they are not usually allowed in utility corridors.

c. Productivity and Economic Properties - when forest habitat types are managed to favor understory species, a negative long-term impact on the timber industry can be expected. Ranchers may benefit in the short run, depending on the palatability of the species reoccupying the site and accessibility to livestock, but overall site productivity would undoubtedly be lower if trees were excluded.

Two principle factors limit the rate of recovery in grasslands and shrublands: (1) available moisture; and (2) grazing (Dyksterhuis 1951). Grazing intensity is the perogative of the landowner; therefore, it is unpredictable and cannot be entered into any calculations. Moisture, then, is the primary analyzable determinant of recovery rate. Moisture is also the main limiting factor for productivity, so alignment of grassland vegetative types along a moisture gradient similar to the one used in determining potential productivity was used in rating grassland recovery rate.

Generally speaking, rangelands in good condition respond more rapidly to disturbances, recovering faster than ranges in poor condition. Therefore, general range condition was taken into consideration in recovery rate determinations.

Power transmission lines constructed in grassland vegetative types, as opposed to forest rangeland types, allow all three criteria of recovery

to be met. Thus no overlaps of recovery rate with forest vegetative types was allowed. Therefore, grasslands were assigned a value of either 1 or 2. According to the State's EIS (DNRC/DEIS 1974), blue grama is present only on the warmest and dryest sites, so the four vegetative types containing appreciable amounts of blue grams were rated 2 with respect to recovery and the other three grassland types were rated 1. The sagebrush vegetative type was considered slightly slower in recovery than the grassland types and rated as 3 (note Table IV-2).

<u>Composition and Value of Data Items</u>

The Rangeland determinant is composed of 15 data items. These data items are discussed in Chapter III and shown in Figure III-8. These 15 data items were assigned high, medium, and low values as shown in Figure V-2.

Two properties that seem best suited to comparatively assess the values of rangeland vegetation are potential range productivity and recovery rate. In assigning impact ratings to the vegetative types, few types fit neatly into one of the 15 data items. Therefore, it became necessary to subjectively analyze each vegetative type not only for range productivity and recoverability potential, but also based on the precipitation zone each vegetative type was most commonly found in, and the relative extent of each vegetative type in the study area.

The recoverability factor was emphasized slightly more than the productivity factor because recoverability potential essentially determines impact duration (i.e., short-term or long-term). For example, the subalpine forest type has fairly low potential productivity, but being assigned the highest potential recoverability impact rating (meaning slowest to recover), and also being very limited in distribution, it was assigned a high impact rating (see Table IV-2).

The Larch-Douglas fir type is also quite slow to recover (rated 4, with 5 considered slowest), but because its potential range productivity is extremely poor (rated 1), it received a low impact rating. The Beartooth Juniper-Limber Pine type is the only other type that received a potential

range productivity rating of 1, but because this type was also given the worst recovery rating, and, because--as mentioned previously--recoverability was given slightly more emphasis than productivity, its impact rating was elevated to "moderate".

The Riparian vegetative type had both the highest productivity rating (5), and the fastest recoverability rating (1). Where transmission lines span rivers and streams, towers are normally placed a sufficient distance back from the stream banks so that direct impacts on riparian vegetation would be minimal and shortterm. The impact rating for this vegetative type was therefore low. The other vegetative types were analyzed in a similar manner and assigned potential impact ratings, as shown in Table IV-2.

It must be emphasized that these impact ratings are based on potential impacts on rangeland only. In other words, in developing the rangeland resource data associated potential impacts on other resources were not considered. To include these would have overemphasized resources such as wildlife or aesthetics, which were already being analyzed as separate determinants.

<u>Determinant Value</u>

The Rangeland determinant was assigned a realtive value of 1 (lowest impact potential). The open rangeland resource would be much less susceptible to impacts from the introduction of transmission facilities than would other land types where the alternative locations are forested land, agricultural land, or residential areas.

The greatest impact on rangelands from the introduction of a transmission line would be removal of vegetation, which would have a direct effect on the livestock industry by reducing the number of acres of available forage. The quantity of forage lost due to the construction of towers and maintenance roads would probably not be significant enough to require reductions in livestock use, or to cause any other major operational changes on ranches located along the corridors.

Recreation Resources

Definitions

The methodology for rating Recreation Resource impacts was changed considerably for Step 2. A change was considered necessary because a more refined information base had been developed to allow a more systematic evaluation of potential impacts on recreation resources.

The Recreation Suitability Evaluation for Step 2 was an inventory of recreation resource values that could be impacted by the proposed Colstrip transmission facilities. The evaluation consisted of the following steps:

1. Selection of recreation land units for all areas crossed by the proposed or alternative corridors - The recreation land units were chosen from the mapping units used on the USDA Forest Service land suitability map (USDA Forest Service 1976a), Figure III-6. It was assumed that land areas with similar characteristics would manifest similar recreation use patterns and similar recreational opportunities, especially regarding dispersed recreation use;

2. Development of a recreation resource value "score" for each recreation land unit - A Recreation Suitability Evaluation Form was used to generate a recreation resource value score for each recreation land unit. The form is displayed and explained in Appendix A-3;

3. Categorizing recreation resource value "scores" into high, medium, or low impact ratings - Recreation land unit socres were plotted on a graph. The resultant two curves separate the recreation land unit scores into high, medium, or low impact ratings (see Figure V-4);

Development and Maps

Resultant impact ratings were plotted on a 1:500,000 map overlay.

Composition and Value of Data Items

Potential impacts on recreation resources resulting from the constructions, operation, and maintenance of twin 500-kV lines were determined by combining the following resource data items:

1. Fish and Wildlife
2. Wetlands
3. Wilderness Areas
4. Primitive Areas
5. Roadless Areas
6. Natural Areas
7. Game Refuges and Areas
8. State Parks and Recreation Areas
9. Wild and Scenic Rivers
10. Scenic Travelways
11. Recreation Waterways
12. Recreation Suitability
13. Scenic Quality

The above resource data items were rated as follows:

1. Because fishing and hunting are not the top recreation activities by frequency of participation in Montana (4th and 8th, respectively), the more highly valued fish and wildlife resource areas were rated moderate for recreation impact sensitivity and the moderate fish and wildlife resource values were rated low for recreation impact sensitivity. Low valued wildlife resources were not rated;

2. Wetlands provide good outdoor recreational opportunities, such areas were rated moderate for recreational impact sensitivity;

3. Special management zones, wilderness areas, primitive areas, roadless areas, natural areas, game refuges and areas, State parks and recreation areas, wild and scenic rivers, scenic travelways and recreation waterways encompass some of Montana's most superlative outdoor recreation opportunities. Each was rated high for recreation impact sensitivity;

4. The recreation suitability data item contains inventoried areas of high, medium, and low recreation resource values. Consequently, this data item relates directly to recreation impact sensitivity. High value recreation suitability areas were rated high for recreation impact sensitivity, moderate value recreation suitability zones were rated moderate, and low value zones were rated low; and

5. "Distinctive" scenic quality zones were rated high for recreation impact sensitivity, "common" scenic quality areas were rated moderate, and "minimal" scenic quality zones were rated low.

Determinant Value

The recreation use determinant was given an overall importance weight of 2 (on a scale of 1 to 3) when compared to other resources. Recreation values are also inherent in the two visual impact determinants which were considered separately.

Land Management Plans

Definitions

Management Objectives for Specified Areas - National Forest land has been subdivided into various-sized geographic areas called planning units. These units are generally characterized by particular patterns of topography, climate, and land use. The function of unit planning is to update the multiple use plans on the National Forest lands. The proposed land management plan for the planning unit must be published in

a Draft Environmental Statement for public and agency review and comment, and the selected management plan is then published in a Final Environmental Statement.

Definitions for the other data items are found under "Fish and Wildlife", "Unique Natural Resources", "Visual", and "Recreation Resources" sections of this chapter.

Development and Maps

Each of the data items comprising this determinant have management plans that are in existence or under preparation. The introduction of a power transmission line through any of these areas would have some impact on the management or the management objectives for the area. It is this impact that is being evaluated.

Composition and Value of Data Items

This determinant includes all of the data items identified under Specially Managed Areas. These are: Wilderness/Primitive Areas, New Wilderness Study Areas, Roadless Areas, Game Refuges and Ranges, State and County Parks, Wild and Scenic Rivers, Scenic Travelways, Recreation Waterways, and Management Objectives for Specified Areas.

A high value was assigned to all data items because of the uniqueness of an area, the legislative support that an area carries, or because an area has specific management objectives that must be recognized.

Determinant Value

A numeric value is not assigned to the data items or to the determinant. If the transmission corridor crosses a data item area, the conflict is noted and the seriousness of the conflict is specified.

An "X" indicates data item areas partially overlapped by a corridor where the centerline could be located within the corridor to avoid the area. The number symbol (#) indicates an area of serious conflict which

could be avoided only by relocating the corridor. A "C" indicates that the transmission corridor location is in conflict with the goals or objectives of a land management plan.

Prehistoric and Historic

Discussion

In Step 1, the analysis of prehistoric data items was based on the limited amount of information compiled at that time. However, additional information from the Forest Service, Bureau of Land Management, National Park Service, and the State of Montana about the location of prehistoric and historic sites made possible a more accurate assessment of potential impacts in Step 2. A number of other changes were also made to enhance the evaluation.

Definitions

Prehistoric - includes three periods as defined by Mulloy (1958). The Early Prehistoric Period is from approximately 10,000 to 15,000 years ago to approximately 6,000 years ago. The Middle Prehistoric Period began approximately 5,000 to 6,000 years ago, after a postulated cultural hiatus of approximately 2,000 years duration. The late Prehistoric Period began approximately A.D. 450 and lasted until the beginning of the 19th century.

Historic - begins with the 19th Century and runs through the early 1900's (20th Century).

Sensitivity - relates to the degree of potential impact on a prehistoric/historic site or other aspect of this resource, and the degree to which this impact could be mitigated without destroying the value of the resource.

Development and Maps

Each known prehistoric site within two miles of either side of the center of a corridor segment was carefully mapped for evaluation. Prehistoric sites outside this area would probably not be encountered in the process of constructing the transmission lines. Therefore, these sites were not considered. As suggested by Montana authorities (Sharrock 1977; Martin 1977), prehistoric data items were not ranked but rather were considered equal in value. In Step 1, concern had been shown for potential prehistoric sites, or sites yet undiscovered. Although the need for assessing the potential for disturbing undiscovered sites during centerline location for all corridors in this study. Therefore, only known prehistoric sites were used for Step 2.

Prehistoric and historic data were plotted on the same map. From the visual resource analysis, it had been determined that the primary visual influence zone would extend a maximum of six miles on either side of the center of a corridor. Since historic sites are usually inherent parts of the visual landscape, those within the above six mile visual zone were mapped for the corridor evaluation. National Register sites were included.

The final map included both prehistoric and historic sites. Each mile of corridor segment along which two or more sites occur was rated high (4), to reflect a higher density of sites. Where there is one site along a mile of corridor segment, a medium value (2) was assigned. Each mile of segment along which there are not existing sites was rated low (1). Thus, a long corridor segment might have a higher value owing entirely to its length. Nevertheless this approach was considered to be consistent with that used for the evaluation of other resources.

Composition and Value of Data Items

It is recognized that all prehistoric and historic sites are essentially of equal and high value. However, a stratification of sites into high, medium, and low sensitivity groups was made to reflect different impact potentials related to the various sites.

Resource data items (sites) were divided into these three sensitivity groups by assessing their potential for being impacted. Site types most difficult to salvage without loss of value were placed in the highest sensitivity category. For the purpose of evaluating segments, each site located within two miles of the segment centerline was considered the equivalent of 1 mile of sensitivity length. To incorporate the density factor, townships with five or more sites were considered to have high sensitivity; one to four sites, medium; and no sites, low.

The following stratification and data item value for known sites was used in the Step 1 Analysis:

<u>High</u>	<u>Medium</u>	<u>Low</u>
Occupation	Subsurface Lithics	Surface Lithics
Fire Hearth	Bison kills	
Petroglyphs	Quarry	
Pictographs	Rock Cairns	
Rock Art	Tipi Rings	
Conical Pole Lodges	Historic Trails (not on National Register)	
Cribbed Log Structures		
Burial	Lookout	
Technology		
Arts		
Military Affairs		
Homestead		
Political Affairs		
Bison Drive with Compound		
National Register Sites		

Higher site density does not necessarily reflect greater historical or research value for the more intensively used area or individual sites within it. All areas and sites have some research values. The potential for physical impact increases with site density and size, but impact may, in fact, be more severe if it occurs on a site in a low density areas. On the basis of research value, it would be difficult to justify one corridor route over another. From the management perspective of

desirability to avoid impact, when numbers of sites is weighed against factors such as age and spatial and temporal extent of sites, corridor selection is not at all clearcut.

In Step 2, National Register sites were not longer considered separately. All prehistoric and historic sites were plotted on the same map and given equal value. However, high, medium, and low values were still assigned based on the density of sites as previously explained.

Determinant Value

The Prehistoric and Historic determinant was given a value of 2 on a scale of 1 to 3. This recognizes a compromise between the relatively high importance given this resource by a select group of professional and nonprofessional people and the lower importance placed on this resource relative to other concerns of many Montanans. This fact was established in public opinion pools and through the analysis of other public comment. Additionally, many prehistoric and historic sites can be salvaged with correct mitigating measures, with the potential impact being reduced to something less than total obliteration, which also justifies the determinant value of two.

Human Population

Definitions

Population Density - refers to the distribution of individuals throughout a specific unit area of the study area, including the urbanized population based on 1970 census data (see Figure III-15).

Proximity - refers to the location of population centers with respect to the corridor segments being analyzed.

Development and Maps

Population disperision within five miles of each corridor segment was examined using the "Population Density" map (Figure III-15). The popu-

lation density of those sections of the study area crossed by corridor segments was then categorized as follows:

Category	Density (pop/sq. mile)
high	$\geq$ 50
medium	5-49
low	<5

Population centers located within one mile of a corridor segment were then factored into this data base. Although all such areas were rated high, the length of segment involved depended on the following criteria:

Miles Impacted	Pop. Center Size
0.5	<500
1	500-1000
2	>1000

These data were combined with the dispersed population density data mapped previously to provide an information base on human population for the areas crossed by corridor segments.

Composition and Value of Data Items

This determinant includes all of the data items identified under Population Density and Proximity (see Figure IV-4). The values assigned to these data items are as follows:

Data Item	Value
<5 inhabitants per square mile	low (1)
5-49 " " " "	medium (2)
$\geq$50 " " " "	high (4)
Pop. center crossed by, or within 1 mile of corridor segment	high (4)

In developing the Human Population determinant, it was considered that the greater the concentration of people, the greater the potential impact. Consequently, the appropriate number analog was assigned to the data items listed above.

Determinant Value

The Human Population determinant was assigned a value of 2 on a scale of 1 to 3. This reflects the moderate to high shortterm impacts on communities expected from construction activities and the low to moderate probability of longterm adverse impact.

Visual Resources

Step 2 Visual data items differ from those used in Step 1. The Study Team found the available visual information inadequate; consequently, a consultant was retained, primary data collected, and a more comprehensive methodology used, as follows.

Definitions

Visual Resources - This term achnowledges that land, water, vegetative, and other landscape features have visual and aesthetic qualities that have become increasingly important to the American public.

Visual Resource Management Classes - These categories define acceptable limits to the visibility of projects in the landscape. Lands of similar visual and aesthetic value are placed in the same class. These classes are:

Class I - Preservation - This class applies to recognized wilderness areas, primitive areas, roadless areas, and proposed wilderness areas. Only natural ecological changes are acceptable;

Class II - Retention - Retention lands are those lands of outstanding or distinctive quality that are seen from roads or areas which are often used or which support activities requiring natural settings. Only management activities or projects that are not visually evident are acceptable. Contrasts created in the construction of a project should be reduced to this level either during or immediately after construction. "This may be done by such means as seeding vegetative clearings and cut-or-fill slopes, hand planting of large stock, painting structures, etc." (USDA Forest Service 1974c:30);

Class III - Partial Retention - Partial Retention lands are lands of high quality-low sensitivity or low quality-high sensitivity. To be acceptable, management activities and projects must be visually subordinant to the characteristic landscape. When seen from a distance, project-related contrasts may not dominate the view. "Reduction of contrasts to meet this objective should be accomplished as soon after project completion as possible or at a minimum within the first year" (USDA Forest Service 1974c:32);

Class IV - Modification - Modification lands are lands of minimal quality that are seldom seen or seen only from areas of secondary importance. Management activities may visually dominate the characteristic landscape, but must appear to be a natural occurrence. Reduction of contrasts to meet this requirement should be accomplished within a year after construction; and

Class V - Maximum Modification - Maximum Modification lands are lands of relatively low scenic quality and visual sensitivity. Management activities may dominate the characteristic landscape, but, when viewed as background, "the visual characteristics must be those of natural occurrences within the surrounding area or character type" (USDA Forest Service 1974c:36). BLM uses Class V as an interim management class for areas requiring rehabilitation or enhancement. Reduction of contrasts to acceptable levels should be complete within five years.

Visual Contrast Rating - This is a method for determining how visible a proposed activity would be in a particular landscape. Visual contrast is rated as high, medium, or low, as follows:

High Contrast Zones - These land areas are characterized by a low-vegetative cover density; shallow, light colored soils; steep to very steep slopes; minimal landscape variety (monotonous landscape character); and a low regenerative capability. Where this type of landscape character with its low-screening potential occurs in close proximity to major use areas, a high contrast situation exists. Some land areas, however, that may have a higher density

vegetative cover and a good soil productivity may also be mapped as having a high contrast potential if other high contrast factors such as steep slopes, light colored soils, and close proximity to high use areas are present.

In high contrast zones, project impacts would be highly visible for approximately three to five miles. Conspicuous corridors and skylined towers would probably result from locating transmission lines in these areas.

Medium Contrast Zones - These are land areas characterized by medium density vegetation; fair to good productivity; and a moderate level of landscape variety that offers fair to good screening potential for the transmission line and its supporting facilities. Some lands with high contrast characteristics (low density vegetative cover, less productive soils, and steep terrain) may be mapped as having a moderate contrast potential should they occur in seldom seen areas. Some lands with low contrast characteristics (high absorptive capability) may also be mapped as having a moderate contrast potential should they be within view of high density use areas.

In medium contract areas, project impacts would be highly visible for 1.5 to 3.5 miles. Towers would often be skylined and corridors minimally to moderately defined. Although medium contrasts are common, they are visually quite significant.

Low Contrast Zones - These lands are characterized by a high degree of absorptive capability. They have a high level of landscape variety, good to excellent vegetative cover, productive soils, soil colors that blend with vegetative colors, a high regenerative capability, and a broken or rolling land form that offers many opportunities to screen transmission facilities. Even though these areas may be near major seen travelways, highways, waterways, or high density use areas, the combined landscape character tends to "absorb" the project impacts.

In low contrast areas, project impacts would be highly visible for one to 1.5 miles. Low contrasts occur only where rights-of-way could blend imperceptibly with the surrounding area and where towers would likely to backdropped. Towers in these areas would be prominent seen from nearby and difficult, perhaps impossible, to screen; however, porject impacts would be visually important only for short distances.

Development and Maps

Visual Resources information was developed and mapped based on concepts and procedures presented in National Forest Landscape Management: The Visual Management System (USDA Forest Service 1974c), and BLM Manuals 6300, 6310, and 6320. The following discussion summarizes information from the Colstrip to Hot Springs Visual Resource Analysis (Wirth 1977) and Appendix A-4, which contains descriptions of information development and mapping procedures. Analysis of visual impacts was based on the interaction of the two data items discussed below - Visual Resource Management Classes and Contrast Rating.

Visual Resource Management Classes - Land within the study area was classified into five Visual Resource Management Classes (Preservation; Retention; Partial Retention; Modification; or Maximum Modification) according to the following three factors:

1. inherent scenic quality of the landscape;
2. visual sensitivity of the area's viewers; and
3. distance from land uses.

These factors were analyzed and visual management units identified through the following process:

1. defining and mapping scenic quality classes;
2. determining the visual sensitivity associated with land uses; and;
3. mapping viewed areas and distance zones.

Based on the above, Management classes were assigned and mapped, as shown on Figure V-5, the Visual Resources Management Classes map.

Visual Contrast Rating - The Visual Contrast data item was based on the BLM system (BLM Manual 6320). Briefly, the system is based on the premise that the severity of adverse impacts depends on the degree of visual contrast between an activity and the landscape. Degrees of contrast are predicted by considering landscape features (i.e., landforms, vegetation, structures) separately. Each feature is broken down into its basic elements (i.e., form, line, color, texture). Based on relative visual importance, contrasts in form were assigned a weight of 4; line, 3; color, 2; and texture, 1. The strength of contrasts that would be caused in each element was evaluated by assigning a multiplicative value of 3 for strong contrasts, 2 for moderate contrasts, 1 for weak contrasts, and 0 for no contrasts. Multiplying the element weight by the contrast strength value gave a score for each element. Element scores were then summed to provide a contrast score for each feature. Finally, the scores for landform, vegetation, and structure features were added for each area. The totals indicate the overall severity of visual impacts. For analysis purposes, the total contrast scores were grouped into high, medium, and low overall contrast categories. Areas in each category were then mapped, as shown in Figure V-6, the Visual Contrast Rating map.

Composition and Value of Data Items

Step 1 included two separate visual determinants, Scenic Quality and Visual Sensitivity. In Step 2, these considerations and others were combined into a single Visual Resources determinant, which is based on the interaction of two data items: Visual Resources Management Classes and Visual Contrast Ratings. Visual Resources Management Classes are based on the (a) aesthetic quality of the land; (b) sensitivity of viewers; and (c) distance from viewers. The Contrast Rating evaluates the visibility of two 500-kV transmission lines in different landscapes. Every mile of the proposed and alternative corridors was placed into a management class and given a contrast rating.

To express the visual impacts in a form consistent with that for other impacts, high, medium, and low values were assigned based on the interaction between the two data items, as shown in Table V-3. For example, a "medium" contrast rating combined with a "retention" management class yields a "HIGH" visual impact value.

The final impact rating assignment procedure, as reflected in Table V-3, was based on the following considerations:

High Visual Impacts - Regardless of contrast ratings, all Preservation lands were rated high in recognition of their legal protection. Because the retention management class required that activities not be visually evident, retention lands with high and medium contrast potential were also given high impact ratings.

Because the Partial Retention class allows human activities to be evident, but not dominant, Partial Retention areas rated both high and medium for contrast were initially included in the high impact category. However because of the resultant poor distribution of highs, mediums, and lows in the study area, medium rated Partial Retention lands were dropped from the high impact category for the final analysis.

Medium Visual Impacts - Land in the Retention Class, where transmission lines would contrast only minimally, was rated medium for visual impact potential. Rating such highly scenic land as "medium" reflects a heavy reliance on the ability of the landscape to absorb the visual intrusion of transmission lines.

Lands in the Modification class have less scenic value than lands in more restrictive management classes; where transmission line contrasts would be high on these lands, medium impact ratings were assigned. Partial retention lands (i.e., high quality-low sensitivity or lower quality-high sensitivity lands) rated medium for contrast were also rated medium for visual impact. This represents an average transmission line impact, an impact which is likely to be quite substantial.

Low Visual Impacts - All maximum modification lands (i.e., lands where visual sensitivity and scenic quality are both relatively low) were assigned low impact ratings regardless of their contrast ratings. Modification lands (i.e., minimal quality lands seldom seen or seen only from points or routes of secondary importance) rated medium or low for contrast were assigned low impact ratings.

Low rated partial Retention lands (i.e., high quality-low sensitivity or low quality-high sensitivity) were also given low impact ratings.

High ratings were assigned a corresponding numerical value of 4; mediums, 2; and lows, 1. The number of miles of each impact category was multiplied by its corresponding value to obtain a final impact score for each corridor segment.

Determinant Value

Public participation in determining location alternatives for the Colstrip transmission line, as recorded by the State of Montana, Department of Natural Resouces and Conservation, shows that there is a high concern for aesthetic values. The Colstrip Study Team voiced the same concern and rated this determinant high (3).

Legal Constraints

The Legal Constraints determinant considers all areas where existing legislation restricts the use of land for transmission facilities. Where resources were considered significant enough to warrant Federal or State protection, they were considered an abvious constraint to transmission corridor location. Data items under this determinant include locations of Threatened and Endangered species of wildlife and vegetation, Wild and Scenic Rivers, National Register Sites, and Natural Areas established by special legislation or administrative action. Encountering any of these areas would constitute a "no go" situation. Consequently, no number values were needed since such constraints are essentially "absolute."